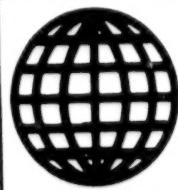


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# ***JPRS Report—***

# **Science & Technology**

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***Europe***

# Science & Technology

## Europe

JPRS-EST-93-006

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## ADVANCED MATERIALS

### Philips Discovers New Electrically Conducting Polymer

93WS0126A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 13 Nov 92 p 8

[Article by TOZ: "Another Current-Conducting Polymer: Approximate Conductivity of Silicon Dioxide Attained by Doping With Foreign Atoms"]

[Text] Frankfurt—Chemists of the Dutch Philips Company have now discovered another polymer with electrical properties—about 20 of them are at present being more closely studied—polycroconain. It has a conductivity of about one hundred-thousandth of a siemens per centimeter, but that can be raised to one siemens per centimeter by selective doping, thereby attaining the approximate conductivity of silicon oxide (quartz). This level of conductivity is also roughly equivalent to that of polyacetylene, with which a number of electrical or electronic applications were tested, but which they were able to replace with polyaniline, which can be more easily controlled.

Polycroconain has very good temperature constancy up to about 300° C. It could therefore be suitable for the production of organic semiconductors for electronic circuits. A peculiarity of polycroconain is that it has a so-called band gap of only half an electron-volt. This substance thus comes quite close to metals or metal alloys, which have no band gap at all. Semiconductors have a band gap of about 2 electron-volts and insulating materials of up to four or more.

Polycroconain is a derivative of so-called crocon acid, a carbon compound containing oxygen with three carbon and three oxygen atoms. It forms a ring-shaped structure composed of five carbon atoms. Its electrical properties are produced by the alternating single and double bonds that occur in the process. This explains the exchange of electrical charges and current conduction in the polymerized chains of polycroconain molecules.

The Philips Electronics NV (NL-5621 Eindhoven, the Netherlands) discoverers describe the new polymer as "organic metal" and synthesize it from a nitrogen compound containing sulphur and the crocon acid. The sulphur and nitrogen components of the polymerized molecule function as electron donors while the remaining component of the molecule absorbs electrons. Since these components of the polymer molecule are

relatively close to one another, the result is low energy band gaps and an exchange of electrical charges that resembles current conduction.

### Berlin University Studies Thin Metal Films

93WS0195C Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 23 Dec 92

[Text] Frankfurt—Extremely thin solid films are proving of increasing interest for science. According to the Freie Universitaet Berlin (Altensteinstr. 40, 1000 Berlin 33), a whirlwind of scientific and technological development is currently taking place in the area of thin films made of metallic magnetic materials. That is why a special research division has been set up at the Freie Universitaet which is to be concerned with research into structures, growth, stability, magnetism and electronic properties of extremely thin solid films.

The background for this research includes work on new magnetic storage media and read-write heads. In addition, new multilayer systems of this kind are used for the development and production of mirrors for X-ray and neutron optics, where surface smoothness must be in the atomic range.

First, thin metallic films are to be produced in Berlin, using the most modern research methods, and their properties investigated. These researches are concerned with fundamental problems which arise in the introduction of a solid body as a film on another carrier and also with all effects which come about as a result of this contact. Thus the FU states that one could speak of a physics and chemistry of "touching" solid bodies. It is said that the substratum plays a vital role here as the carrier of the film, since it can force a structure on the film which differs from that in its interior.

It is said that this behavior can lead to the formation of unusual changes which are not attainable in any other way. Influences which come about through the atomic structure of the carrier and the films will also be investigated in Berlin. These might include defects, steps and cavities.

It is also said that the manufacture, structures, characterization and measurement of the physical properties of thin films require special methods of material characterization and the most sensitive measurement methods of surface physics and vacuum technology. Detailed calculations of the electronic structure are to be compared to the experimental results in order to be able to understand the phenomena as comprehensively as possible.

**Hoechst's Research in New Plastics Described**

*93WS0204A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 4 Jan 93 p 10*

[Article by Harald Cherdron, Professor Doctor, Director of Central Polymer Research at Hoechst AG in Frankfurt: "On the Way to Technical High-Performance Plastics with Planned Property Profiles"]

[Text] Frankfurt—In recent years, rather than developing completely new polymers, the improvement of plastics already on the market is increasingly gaining in importance. One of the reasons for this is the desire of many users to reduce as far as possible the previously sought-after wide variety of plastics in the interests of more economical recycling.

Moreover, in many cases time and cost advantages also argue in favor of constantly improving the standard plastics already in use. At the same time, of course, researchers at Hoechst are also developing new polymers which would open up interesting applications as structural or functional materials.

The plastic polypropylene exemplifies how a familiar old polymer can be improved by varying its spatial form. By means of the new metallocene catalysts (metal complexes built up in sandwich fashion) it is now possible to specifically produce not just the isotactic, but the syndiotactic structural variants of this substance as well.

Syndiotactic polypropylene possesses a clearly improved and expanded property profile. The defined spatial structure results in a considerably more transparent product with increased impact resistance. Thus, the previous standard polymer, single-step polypropylene (PP) has taken another step in the direction of being a technical plastic.

A more efficient way of modifying the properties of a polymer is based on the introduction of changes in its chemical composition. For example, the composition and form of the main chain, which, as it were, comprises the "backbone" of the polymer, can be modified by means of additional basic elements. Whether these elements are added in the form of interdependent blocks or are uniformly distributed in the main chain, copolymers, whose properties may significantly differ from the basic plastic, are developed.

The specific development of such copolymers constitutes an elegant way of forming a balanced property profile in a polymer material. One example of this is the plastic polytetrafluoroethylene (PTFE)—a highly desirable material that is exceptionally resistant to chemicals and corrosion at temperatures between -200 and +260°C.

Unfortunately, in pure form polytetrafluoroethylene is not thermoplastically processable using existing methods. Instead, relatively expensive sintering techniques or RAM extrusion have to be used to produce useable moulded parts. To alleviate this shortcoming,

researchers at Hoechst have used several new basic elements in order to control the regular structure of the PTFE main chain to a greater or lesser degree. The resultant copolymers exhibit the same high temperature resistance as the basic material. But, in addition they can be extruded or processed in injection moulding machines.

Hoechst has successfully employed the strategy of varying the structure of a main chain by means of heteroatoms or functional groups as exemplified by numerous new polymers. One example of this are the polyaryls, which possess—to an exceptional degree—a high chemical and thermal load-bearing capability. The prototype of this compound family—poly-p-phenylene—is insoluble and only melts at temperatures over 500°C.

In this case, too, technically usable products can be developed, when the carbon main chain is suitably modified. Were, say, a sulphur atom inserted between the aromatic rings, the plastic polyphenyl sulphide (PPS), which is characterized by extremely good chemical resistance and inherent flame resistance, develops.

The properties of polyphenyl sulphide can be improved to the degree that it can even replace metals. In a particularly robust form, polyphenyl sulphides have also been used in machinery and equipment manufacturing and electronics. In an essentially similar way a variety of technical plastics like polysulphon, polyether sulphon, polyether ketone, as well as material classes of the aromatic polyamides and polyesters have been developed. They all qualify for a number of technical applications.

Among the aromatic polyesters developed by Hoechst is a liquid crystalline polymer that possesses an unusual combination of high tensile strength and a high elastic modulus. Many properties of this material, like its extremely low thermal expansion coefficient already resemble ceramic construction parts in formulations.

The properties of a plastic can also be improved by being mixed to a greater or lesser degree with other polymers. In the alloys (blends) so derived, the properties of the involved components are present, so that products may be produced with a planned property profile.

The existing classic representatives of polymer alloys are multiphase blends consisting of thermoplastics with elastomers. Thus, the extraordinarily versatile polypropylenes can be alloyed with small amounts of rubber on an ethylene/propylene/diene base (EPDM). A material is derived from this procedure that retains to a good extent the hardness and rigidity of the polypropylenes, but that also enjoys an unusual degree of impact-resistance and a high shock-bearing capability. Because of these properties as well as its recycling capability, it is increasingly being used in automobile manufacturing as spoilers and bumpers.

Unfortunately, only a very few polymers are homogeneously alloyable with each other. In a similar fashion, Hoechst researchers have succeeded in producing blends from high-performance polymers, in which up to three different plastics (polyether imide, polyether ketone, and polyarylate) can be alloyed with each other homogeneously in almost any ratio.

The combination of these polymers is therefore especially attractive, since even small portions of polyarylate and polyether imide reduce the high viscosity of melted polyether ketone and therefore decisively facilitate the thermoplastic processing of this high-performance material. The glass transition temperature of these ternary plastic alloys can even be set smoothly between 165 and 217° on the basis of the mixture ratio of the three components.

This unusual planned behavior of a plastic demonstrates the enormous potential of polymer blends, whose development has to be promoted even further. Blends from polyether imide and polyarylate harbor yet another surprise, namely, a transparent alloy, whose refractive index can be specifically set on the basis of its composition, is derived from both polymers.

Should one want to improve the properties of a third, similarly transparent material, combination with this alloy suggests itself, since its refractive index could be adjusted precisely to the new material. In this way, so-called "isofractive blends," which even remain transparent when the alloy from polyether imide and polyarylate is incompatible with the third polymer, occur.

The properties of a polymer can also be improved if it is fortified with glass, aramide, or carbon fibers. For this purpose, as a rule, short (at most 0.5 millimeter in length) fibers are irregularly distributed in the plastic matrix. Researchers at Hoechst Celanese have now successfully fortified polymers with fibers that are about 10 times longer and sometimes even endless. These fibers are uniformly arranged. Their percentage by weight can reach 80 percent. Long-fiber reinforced thermoplastics, which can be recycled materially in high quality, can, owing to their outstanding mechanical properties, even substitute for metals at great savings.

Unlike structural materials, polymer functional materials must offer additional properties, which are initially completely atypical of plastics. One example of this are polymer light waveguides, which transmit data optically and from which an extraordinarily high transparency is therefore required.

Even higher requirements are put on plastics with nonlinear optical properties (NLO). Their function—light transmission—must also be able to be controlled by external electrical fields. To this end, NLO-polymers have the important key element chromophore at their disposal. Originally, this chromophore was dissolved in the polymer matrix.

Researchers at Hoechst Celanese have, on the other hand, added the structural element firmly to the side chain of a methacrylate polymer. The resultant material can, given good nonlinear optical properties, be processed comfortably and is stable in the face of temperature loading.

Another interesting development in functional polymers are the membranes, which are also stable at high temperatures in the face of organic solvents. For the first time ever, Hoechst researchers have successfully developed more efficient ultrafiltration membranes based on polyaramides. Such membranes are, for example, ideal for the elegant recovery of expensive catalysts. Often they can replace a distillation process and contribute to economical chemical production processes.

## AEROSPACE

### German Study Shows Feasibility of Hydrogen-Fueled Aircraft

93WS0134A Duesseldorf HANDELSBLATT in German  
23 Nov 92 p 13

[Article by BEU: "German Aerospace Airbus: Conceivably Operational by 2010. Possibly Hydrogen-Powered"]

[Text] Hamburg, HANDELSBLATT, 21-22 Nov 92—The use of liquid hydrogen instead of kerosene to provide power for aircraft is feasible. This is the finding of a feasibility study conducted by German Aerospace Airbus, Ltd., Hamburg, in conjunction with various partners. In the course of the study, begun two years ago, it was furthermore established that, in comparison with liquefied petroleum gas, the use of liquid hydrogen is more advantageous for reasons of safety, low ecological impact, and long-term availability.

The feasibility study on the use of supercooled gases is part of the joint German-Russian "Cryoplane" project. Participating in it under the direction of German Aerospace Airbus are the Russian firms Tupolev and Kuznetsov of the Commonwealth of Independent States, as well as German Aerospace, Linde, MAN [Augsburg-Nuernberg Machine Factory, Inc.] Technology, Messer-Griesheim, Uhde, Garett, Liebherr, German Lufthansa, the Berlin Airport Company, and the Max-Planck Institute for Meteorology in Hamburg.

This will be followed by the next operational phases of development of the technology and components, a demonstrator phase, and development and production of the mass-produced aircraft. They plan to use a modified Airbus as a demonstrator for the development of the mass-production aircraft. According to current plans, the hydrogen-powered airplane could probably be operational in the European air-route network by 2010. The designers recommend that the hydrogen tanks be mounted on the top of a modified Airbus. Individual components such as pumps, valves, and heat exchangers

are still to be further developed. The production of suitable combustion chambers is viewed as being especially necessary.

### Prospects, Problems of Cooperation With Russia Viewed

*93WS01764 Rotterdam NRC HANDELSBLAD  
in Dutch 16 Dec 92 pp 18-19*

[Article by Ferry Versteeg: "The Faded Ambitions of European Space Travel"; first paragraph is NRC HANDELSBLAD introduction]

[Text] Although the European Space Agency (ESA) is seeing its budget decline, it is clinging to its old pretensions: Europe, too, must enter space. But it will not do so alone.

A greater contrast is scarcely conceivable. The Hague, 1987: During an optimistic conference of ministers from the 13 member states of the European Space Agency (ESA), cries of jubilation were heard over an ambitious plan to give Europe an equal and autonomous position as a bigwig in space travel. The plan included, besides the Americans and the Soviets, Europe's own Hermes space shuttle and its own Columbus space station, manned by European cosmonauts. No longer would the Europeans, with hat in hand, have to ask others for a ride into space. The plan would be a powerful symbol of what a unified and renewed Europe can do.

Granada, last month: Once again the ESA ministers met, but there was little sign of the previous idealism in the southern Spanish city. Bickering—that new European party game—was the order of the day. This time, postponements and cancellations seemed to be the trump cards. And the ESA budget for the rest of the 1990s did not increase by the intended amount, but rather fell by 13 percent to \$26 billion. Nevertheless, the malaise was to a certain extent camouflaged with a new magic phrase: space cooperation, primarily with the Russians, naturally with the Americans as well, and possibly even with the Japanese.

Why have European space travel ambitions faded so much in only a few years? Naturally the ESA countries have been struggling with economic head winds and tight finances since 1990, while the Germans are also wrestling with the unexpectedly high costs of reunification. At the same time, the most prominent ESA projects have exceeded their original budgets, sometimes by dozens of percentage points, because of overly optimistic calculations and technical setbacks. Furthermore, the view has gained ground that the end of the Cold War offers inhabitants of earth more opportunities for cooperation in the extremely expensive field of space exploration.

And why not? The Russians, who inaugurated the space age in 1957 with the launch of their Sputnik, are now bursting with know-how and experience but groaning under a total lack of funding. The Europeans are embroiled in a race to catch up technologically, and

despite the economic head wind they still have a reasonable amount of money. And the Americans are technologically superior, but are struggling at the same time with the biggest budget deficit in our star system. "The battle for prestige in space is over," says Roland Deschamps, the head of the European rocket producer Arianespace. "Every country in the world is trimming its space programs and is now in a period of reflection." At his Paris headquarters, Jean-Marie Luton, the general director of the European Space Agency, adds: "Pooling economic and scientific resources can only serve to promote space research."

The original European space program was primarily supported by three pillars: the new Ariane-5 rocket, which has a payload of 21 metric tons and will be launched for the first time in 1996; the Hermes manned European space shuttle, scheduled to be put into space by the Ariane-5 by the year 2000; and the two likewise manned Columbus space laboratories, which will be supplied regularly by Hermes. Of these two space laboratories, one would be attached to the U.S. Freedom space station—which has yet to be launched—in 1999, while the other one would orbit the earth freely and gradually develop into a complete European space station.

But the ESA ministers, including "our" J.E. Andriesen, decided differently last month in Granada. The Hermes shuttle and the free-flying Columbus space laboratory, the two most expensive ESA projects, are being mothballed.

The ministers left the rest of the ESA program intact. Thus, advanced development of the Ariane can be continued, because it will amply pay for itself through commercial satellite launches. The Columbus space laboratory that is to be coupled to the U.S. Freedom station also survives in a somewhat cheaper form. In addition, the ESA promises to invest extra money in satellites for earth observation and telecommunication.

Instead of the Hermes space shuttle and the free-flying Columbus space laboratory, ESA is investing \$127 million to 1996 in a European-Russian study to examine whether a joint Euro-Russian space shuttle and space station can be built. "Over the next three years, we will examine with the Russians what our mutual needs are and on the basis of that set up a joint space program," ESA chief, Jean-Marie Luton, says.

On paper, the possibilities for mutual advantages seem great. There is no question that the Russians can contribute a torrent of relatively cheap know-how and expertise. Their space industry is very broadly developed: last year, despite the economic misery and charity campaigns such as "Help the Russians Through the Winter," another 70 large Russian rockets were launched into space. Their first Soyuz ships went up 30 years ago, and later versions of that machine are still serving the Mir-1 space station. It was not that long ago that the Russians unveiled a new space shuttle, the Buran, which

is suspiciously similar to NASA's shuttle. An additional advantage for the Europeans, of course, is that the three-year study with Russia offers a welcome "budget break." And if the economy has picked up again in 1996, then it is hoped at ESA headquarters that spending on space exploration can swell once again.

It is not implausible, in turn, that the Russians' mouths are watering at a \$127 million joint study. After all, most of their space projects are stagnating for lack of money, and their best minds are threatening to leave. After only one flight, the Buran shuttle has been grounded, expansion of the Mir-1 station is stagnating, and it is highly uncertain whether the Russians will be able to launch the Mir-2 station in 1996 on their own. "If you give them money, they will do anything for you," said a Japanese television journalist who for a price was recently allowed to go along on an excursion to the Mir-1. "Actually, it is all quite disagreeable."

Still, there is room for doubt. Is the European embrace of the Russians not a mere palliative, a cover for European inability? Is the spirit of "The Hague 1987" definitively a thing of the past? General director Jean Marie Luton of ESA, himself a prominent space scientist, denies this. "We are sticking to our intention to play a main role in space. Our budget doubled from 1982 to 1992, but because of momentary economic problems we have been forced to mark time for a few years. Now it appears that we can no longer do everything all at once and that for the time being we must adopt a step-by-step approach. Moreover, the international political situation has undergone drastic changes. We are now in a phase in which space exploration is becoming a worldwide operation. And the decisions at the recent ESA conference in Granada enable us to participate fully in that game."

The question is whether, in practice, the cooperative project with the Russians does not in fact boil down to Europe cosfinancing the Russian Buran shuttle and the Mir station. "If that is the Russian intention, then our cooperation will not get very far," says Luton. "On the other hand, we will not assume the attitude of a grocer simply trying to pick the currants out of the Russian porridge. Over the next three years, we must find an intelligent way of cooperating in which the interests of both parties are carefully balanced."

According to the ESA chief, the Russians have been on the move with their Soyuz ships and Mir station for several decades now. "It is a solid system, but with limited possibilities. Now they also have the Buran space shuttle, but it is too complex and too expensive. The Russians have let it be known that they want to develop an advanced but simpler and cheaper shuttle with us. Thus, something like our Hermes." The interesting thing, according to Luton, is that the Americans are thinking in the same direction. "NASA is no longer planning to expand its current fleet of extremely expensive space shuttles or to replace them in due course with similar shuttles. On the contrary, the Americans too are now thinking about developing a less complex, more

automated, and cheaper shuttle. To me, that is a sign that Hermes is the concept of the future."

Luton wants to reserve one-third of the \$127 million study with the Russians for further elaboration of the Hermes concept. The remainder will go into financing three space flights by ESA cosmonauts in Russian space installations, into purchasing European components for the new Mir-2 station, and into developing a new European-Russian space station, which should be put into orbit between 2005 and 2010.

Still, for the time being, the road to Euro-Russian space cooperation remains strewn with land mines. The most important one is the uncertain political situation in Russia. Will the current negotiating partners still be in place six months from now? In addition, the tension among former Soviet republics makes the future of strategic space research and launch installations unclear. Will Baykonur, the largest launch GOS facility, which is now in independent Kazakhstan, remain accessible to the Russians in the future? Two young Russian engineers who recently returned to Moscow from Baykonur told the foreign press there that most of the staff members at the center have been made inactive due to the lack of money and the chronic Russian-Kazakh quarreling over the division of the space program.

And then there are the inevitable technical complications. An example: The Russians would like to launch a future space station from their territory, and thus into an orbit approximately 65 degrees relative to the equator. But the European Ariane rockets tend to maintain an orbit of 28.5 degrees from their base at Kourou in French Guiana. An Ariane launched from Russia would have to sacrifice a substantial share of its load capacity. "I will certainly not deny that there are risks associated with Euro-Russian cooperation," Jean-Marie Luton admits. "But I think that the advantages clearly outweigh them. In addition, we are not committing ourselves for the long term. We are giving ourselves three years' time to reach an accord on the content of our joint mission, on work methods, on industrial programs, etc. Only then will we make definitive decisions."

One acute source of friction is the stormy Russian entry into the lucrative market for commercial satellite launches, half of which has been dominated thus far by Europe's Arianespace with the remainder going to the U.S. firms General Dynamics and McDonnell Douglas. Thus, the London-based telecommunications consortium Inmarsat decided last month to send one of its Inmarsat-3 satellites into space on a Russian Proton rocket. An identical satellite is going up with an Ariane-4 rocket. The Russians are asking \$37 million for this, the Europeans, \$62 million. Is it any surprise that the Washington-based Intelsat consortium also hopes to take the plunge with the Russians before long?

Jean-Marie Luton can understand the furious reaction by Western launchers. "Naturally it must be possible to cooperate with the Russians while at the same time

competing with them," he says. "But the current situation on the commercial launch market is unfair, because the Russians are operating from a nonmarket situation. Thus, we must formulate fair rules in order to guarantee normal development. That is also something that we are discussing with the Russians."

What happens if Euro-Russian space cooperation falls through anyway? "Then we have two other options," says Luton. "We can then try to expand the existing cooperation with the United States. There is certain interest in this in Washington. The Americans want to curb their budget for space research and will be happy to share the costs for certain developments. Finally, Europe always has the option of continuing autonomously. After 1995, in a hopefully improved economic situation, our ESA budget will increase again. I am firmly convinced that Europe cannot do without space transport and further space research."

[Box, p 19]

#### The Netherlands in ESA

The European Space Agency must maintain the strong position that it has managed to develop in the past. This was the message from Minister of Economic Affairs Andriessen last October in Noordwijk, where he was opening a new testing center for ESTEC [European Space Research and Technology Center], ESA's largest research center, where approximately 1,800 mostly highly skilled scientists work. However, these bold words from the "high tech" politician scarcely fit in with the extremely modest Dutch contribution to European space travel. Over the coming years, the Netherlands will spend 190 million guilders per year on space travel, two-thirds of which is through ESA. That is 2.47 percent of the total ESA budget. Based on our gross national product, our contribution should be twice as much.

This fact is being criticized by other European countries. Not least of all because ESA is investing three times the Dutch contribution in study at ESTEC in Noordwijk. In addition, Dutch industry receives another 200 million guilders in ESA orders every year. The foremost recipient of this is Fokker Space and Systems (FSS), which is developing a 10-meter robot arm with which future European cosmonauts will be able to perform tasks outside their space shuttle or station. FSS may consider one year whether to go with its parent company Fokker to DASA or to look for another form of cooperation.

#### CNES To Test Ariane-5 Solid Propellant Booster

93WS0182A Paris AFP SCIENCES in French  
3 Dec 92 pp 10-11

[Unattributed article: "First Test of Ariane-5 Strap-on Booster in February 1993"]

[Text] Cayenne—The first test of one of the two Ariane-5 strap-on boosters is expected to take place in February 1993, according to Mr. Jean-Marc Artaud, head of the

Ground Subdirectorate at the CNES [National Center for Space Studies] in Guiana.

"The integration campaign of the first powder-propellant test unit was resumed on 23 November," he said during a visit to the construction site of the building where the final assembly of the future European launcher will take place. "It should lead to a first test during the second half of next February."

Mr. Artaud indicated that, after spending eight months to fix minor technical problems encountered during assembly of the booster first segments, the work schedule, which had been slowed down, has resumed its normal rate.

The planned test will be "a world first" because "a booster with a reinforced structure of that size has never been tested in its vertical position exactly as it will stand when Ariane-5 takes off." There is one difference, however: the booster will be maintained to prevent it from getting out of the test benches. It will hang from the concrete tower specially built above an excavation nearly 200 m long and 65 m deep, dug into granite.

In addition, Mr. Michel Mignot, head of the Guiana Space Center (CSG), mentioned the impact that the recent European space conference in Granada will have on Guiana. "The commercial workload for Ariane-4 launches was confirmed until 2002, as were Ariane-5 and studies concerning other launcher versions," he said.

"On the average," Mr. Mignot added, "an average rate of seven Ariane launches per year is expected until 2002. The economic benefit to the department may be estimated at about 1 billion French francs [Fr] per year. After this decade (1992-2002), the objectives of the CNES and its partners in Guiana will be to maintain the competitiveness of Ariane, to develop the Guiana Space Center, and to fight to get the Hermes program launched from Kourou."

Mr. Mignot indicated that he would start work "sooner than expected" in the construction, civil engineering, tourism, and training sectors, and "thus show his desire for integration into Guiana's development." The space sector, which brings Fr1 billion per year to Guiana's economy, will contribute "to aid the development" of Guiana in the intermediate and long term, as was recently recommended by the minister of overseas departments and territories, Mr. Louis Le Pensec, in his recovery plan.

To revive the local economy, the CSG also prepared a "plan to develop tourism in Guiana." Five hundred guests and tourists were thus able to attend the last Ariane launching from the two new observation sites, Colibri and Agami. The new "Space Museum" will be completed by the end of 1993, and the Iles-du-Salut tourist center, off the Kourou shore, will also be modernized. "A one-week trip of discovery of the space

center and Guiana's heritage might be offered soon for Fr9,000 (roundtrip from Paris) by local travel agencies," Mr. Mignot added.

Finally, the CSG is pursuing its "plan to develop education for all in Guiana and turn space center jobs into local jobs, to promote the local work force and make young Guianese aware of future technical jobs."

For its part, the CNES agreed to extend by two years its contribution to the PHEDRE program (1989-1996 Hermes Partnership for Regional Development) through an additional contribution of Fr120 million. The CNES thus becomes, with the state and other social and professional organizations, one of the largest partners of the future "Guianese Participation Fund" that will be implemented early in 1993.

### Eumetsat Approves Second Generation Meteosat Program

93WS0182B Paris AFP SCIENCES in French  
3 Dec 92 p 13

[Unattributed article: "Eumetsat Decides to Acquire Its Own Control Center"]

[Text] Paris—At its last council meeting, held in Darmstadt on 23-25 November, the European organization for weather satellite operation, Eumetsat, decided to set up its own satellite control center in that German city.

The council also approved in principle the Meteosat second-generation satellite program and decided to consider as highly probable its participation in the European polar platform program geared to meteorology, the Metop program.

The new Meteosat satellite control and data-processing center should be completed by 1995; it will be connected to the new tracking station in Fucino (Italy), the first of a series of stations that will probably be set up later on.

Eleven of the 16 countries belonging to the organization have already approved in principle the Meteosat second-generation satellite construction program; the program should start next year, after it has been approved by all members. These three satellites, which should be used starting in the year 2000, will provide 10 times as much data as the Meteosat satellites currently in service; in particular, they will provide images of the clouds every 15 minutes, plus data on climate prediction and monitoring.

Simultaneously, the Eumetsat council decided to prepare the definition of the Metop polar platforms geared to meteorology, which will constitute the next century's weather satellite. This type of platform was approved at the European space ministers conference in Granada, on 9-10 November, and it will become part of the international MSG system to increase weather data and facilitate research on the planet overall climate. The Eumetsat director, Mr. John Morgan, said he was confident that

the programs proposed would receive final approval before mid-1993, so that they could be launched with ESA [European Space Agency] collaboration.

Five Meteosat satellites, built by a consortium of European companies with Aerospatiale as the prime contractor, are currently in orbit and provide weather data to all of Europe. The sixth satellite, now being built in Cannes, is scheduled to be launched by Ariane late in 1993. Two more have been ordered.

### Airbus A-319 Postponed

93WS0182C Paris AFP SCIENCES in French  
3 Dec 92 p 18

[Unattributed article: "Launching of Airbus A-319 Project Postponed"]

[Text] Paris—The start of the A-319 project, the shorter 130-seat version of the A-320 twin-jet, was postponed because of a lack of orders, the Airbus Industrie managing director, Mr. Jean Pierson, indicated on 26 November, during the Mexico-Paris endurance flight of the four-jet A-340.

"We shall have to wait longer than expected," Mr. Pierson stated, referring to present conditions in the aircraft industry, which are very difficult. "We do not have any order yet. The first order will be received by the end of the year, and we shall launch the project for good only when we have enough orders."

The Airbus managing director emphasized the extent of the crisis, indicating that only three of the 65 options to purchase A-320s that matured in 1992 were exercised. Mr. Pierson, which counted 98 Airbus orders in 1992 hopes to pass the 100-unit mark this year (by about 20 units, according to a well-informed source), as he did in 1991 (101 orders), which is far from the 1989 record of 421 orders.

When it started its "sales prospecting" for the A-319 among airlines in 1992, Airbus hoped at first to gather enough commitments for the purchase to start building the plane before the end of 1992; then it postponed its decision to the beginning of 1993. The plane is expected to be set into service by the end of 1995.

### German Aerospace Research Institute (DLR) Demonstrates Newly Developed Laminar Flow Wing

93WS0190A Duesseldorf VDI NACHRICHTEN in German 11 Dec 92 p 15

[Article by Wolf-Heinrich Hucho: "Researchers Outwit the Air Flow"]

[Text] VDI-N, Braunschweig, 11 Dec 92—Laminar flow wings could soon be saving fuel in commercial air flights. What had long been known theoretically in textbooks turned out to be an unexpectedly difficult task to convert to reality.

There are a multitude of reasons why aviation would want to be able to save on fuel consumption. Fuel alone accounts for about 12 percent of direct operating costs (DOC) of any airline company. For that reason alone, each percentage point of saving is worth fighting for. Low fuel consumption equates to a greater flight range and a greater payload. Moreover, the environment, too, would benefit if less kerosine were roasted into  $\text{CO}_2$  and steam. There are many ways to approach the problem of reducing aircraft fuel consumption. The three most important are: more efficient engines, a lower structural weight, and improved aerodynamics. The German Aerospace Research Institute (DLR)—in its work in aerodynamics—has now demonstrated that even after almost 100 years of advances in aviation technology the full potential of further breakthroughs has not been exhausted. Laminarization is the keyword.

Right at the onset of his presentation in Braunschweig, Professor Thomas, DLR board member, made clear that even the idea of laminarization has been known for a long time. The principles of the boundary layer theory had been laid out by Ludwig Prandtl years ago. It was Prandtl who showed that air drag can be reduced by laminarization. It turned out to be extremely difficult, however, to devise practical technical solutions for this textbook truism.

About half the air drag encountered by a commercial aircraft can be attributed to friction. The air particles streaming around the aircraft adhere to its walls. A boundary layer develops in which the flow velocity grows from the zero value on the aircraft walls to the full value of the external flow. This usually thin boundary layer knows two states. If the flow velocity is low or the flow-run length short—both parameters can be combined in the Reynolds number—then the flow in this boundary layer runs in ordered layers. It is laminar and results in comparatively little drag. In the case of larger Reynolds numbers, the boundary layer can become suddenly turbulent. A brisk transverse transport of "air balls" provides for an intensive pulse exchange, which is the equivalent of heightened air drag. A trick way must be found to prevent or at least delay this laminar-turbulent transition.

One can show clearly—with a single number—what order of magnitude is involved. The air drag of an Airbus in flight would be reduced by a factor of 10, if it were possible to keep the boundary layer completely laminar on all its part. Unfortunately, this will probably never be achieved. However, Dr. Koerner, the director of the DLR institute for design aerodynamics, and his team, believe they can manage to achieve 20 percent of that figure. There are two ways to attain this ambitious goal. The first approach would be to slow down—as far as possible—the transition from laminar to turbulent flow solely by improving the form of the profile and the quality of its surface. When one views such laminar profiles, it is immediately obvious that their greatest thickness is situated far to the back. In this way, the flow over the profile can be accelerated over the greatest flow-run length possible, thereby reducing the chances of sudden change from laminar to turbulent. The ensuing

pressure increase should not be chosen so steep that the turbulent boundary layer separates. Without such a profile, high-performance soaring vehicles would be inconceivable. However, they are comparatively slow. Laminar technology had to attain greater flight speeds, and expand its application range to greater Reynolds and Mach numbers.

The second approach—artificial laminarization—is much more expensive. In order to keep the drag increment small with the Mach number, advanced modern aircraft have sweep wings. On these wings, the transition of the natural boundary layer to turbulent invariably occurs at the wing nose. It can be prevented from occurring there and shifted further downstream if air in the vicinity of the wing nose is sucked off. The DLR researchers made it their goal to accomplish both of these solutions.

Four component problems had to be solved. In the first, the aerodynamicists developed efficient calculation procedures for the design of laminarized profiles. The most difficult aspect at this stage was predicting the onset of the laminar-turbulent transition. The problem was solved experimentally in flight and wind tunnels. Next, the researchers at Braunschweig executed a series of practical profile designs and then tested their calculation procedure on them. The theoretical predictions were confirmed exactly. Then the effort again turned to flight testing. It was now a problem of clarifying the so-called operational problems. A wing does not simply operate in the clinical atmosphere of a wind tunnel. The effects of propwash and insect invasion on the laminar-turbulent transition had to be determined as well. To effect the wing nose suction, a procedure for introducing tiny drillholes in the wing nose and preventing them from being stopped up (e.g., by icing) was developed. All four component problems were solved. Now laminar technology can finally go into production.

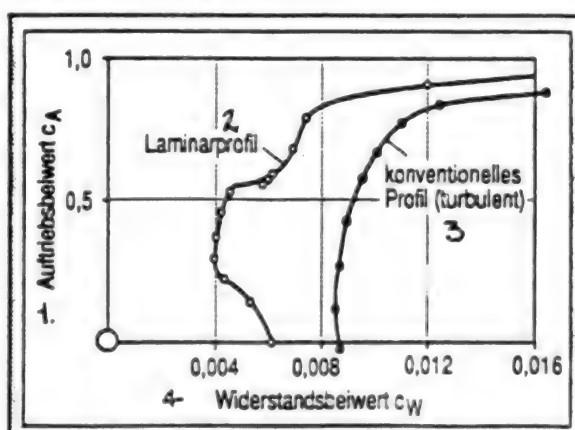


Figure 1. The newly developed laminar flow wings clearly display better drag coefficients than conventional wings.

Key: 1) aerodynamic lift  $c_A$  coefficient; 2) laminar profile; 3) conventional profile (turbulent); 4) drag coefficient  $c_w$

### German/Japanese Project on Reusable Space Vehicles

93WS0195A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 17 Dec 92 p 8

[Text] Bonn/Tokyo—With the joint space flight project "Express," Germany and Japan hope to investigate problems in the entry of reusable space capsules into the earth's atmosphere. After several years of preparation, this Thursday in Bonn an agreement to that effect will be signed by the German space flight agency DARA and the Japanese Ministry for International Trade and Industry (MITI). This is the first project of this kind involving the cooperation of the two states in space flight research.

The chief object will be an unmanned capsule of the proven Russian Salyut type. This vehicle is to be readied for the research project in cooperation with Russian scientists. The Federal Minister for Research, Heinz Riesenhuber, had met with agreement from the Russian side during his conversations in Moscow over the summer. Part of the background of this cooperation is the desire to assure employment for the scientists there.

Japan is providing a rocket of the standard M-3S type and will be handling the takeoff planned for February 1993 from a space flight center in southern Japan. After orbiting the earth for five days, the capsule is to land in Australia by parachute. Responsibility for the scientific portion belongs to the Japanese Ministry for Culture and its Institute for Space Flight and Astronautics (ISAS); responsibility for the commercial portion belongs to the space flight agency NASDA, which is under the authority of the Ministry for Research in Tokyo.

According to the announcement in Bonn, Germany's financial share is to amount to DM30 million, of which DM10 million will go to the Salyut capsule and DM20 million will be allocated for scientific experiments. German sources give Japan's financial contribution as about DM60 million, including the rocket. But Japanese newspaper reports, citing government sources, speak of a total sum of ¥16 billion (DM200 million), to be shared by the two sides.

### Optical Transmission of Steering Commands Tested

93WS0195B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 17 Dec 92 p 8

[Text] P.O. Hatfield—In the overwhelming majority of all passenger planes now in use, the pilot's steering commands are still transmitted mechanically to the

corresponding steering elements in the wings and tail. Nevertheless there have been for some time a few civilian aircraft types in which transmission is carried out by cables instead. An example is the small A-320 airbus.

But even this form of transmission, the so-called "fly by wire," could be a thing of the past within a short time. Even before the end of 1992 the first commercial aircraft redesigned for optical light transmission will begin a comprehensive testing program in Europe.

What is causing aircraft manufacturers and their suppliers to perform an expensive experiment with the glass fiber cable transmission of steering commands? If the "fly by light" turns out to be practicable, it offers two advantages which are significant in long-term aircraft operation. First of all, the glass fiber cables are incomparably lighter than traditional copper wiring.

In a fairly large commercial aircraft that means a weight savings on the order of magnitude of a hundred kilograms. In the short term that does not sound like much. But with tens of thousands of flights in the life of an aircraft, such a weight reduction, which leads either to an increase in cargo or a reduction in fuel consumption, is certainly significant. But a second point appears even more important in current thinking: data transmission via glass fiber cables is not affected by electromagnetic or radio frequency interference, which must be taken into account when considering the safety aspects of "fly by wire."

In Great Britain Lucas Aerospace has developed a "fly by wire" system over the last few years which is now to confirm the results of previous experiments in reality in a commercial aircraft of the BAe 1-11 type in cooperation with British Aerospace.

A flight program of 500 hours is anticipated. The aircraft will receive a special operating permit from the British aviation authorities which will even permit British Aerospace to carry internal (i.e. non-paying) passengers on the relevant flights. The Lucas system which has been installed is not yet a "fly by light" installation including all steering functions. Instead, only steering commands for the system of flaps on the wings will be transmitted by glass fiber cables.

The pilot's relevant steering movements will be detected by sensors and transmitted to a computer in the cockpit, which will then convert them into light signals and transmit them to the flap actuators in the wings. These will react to digital signals and will also automatically confirm execution of the commands.

**AUTOMOTIVE INDUSTRY**

**French Cities To Test Electric Car Technologies**  
*93WS0135B Paris L'USINE NOUVELLE in French*  
*19 Nov 92 p 28*

[Article by Nadine Bayle: "Who Will Ride the Electric Car?"]

[Text] Calls for bids have been sent out to builders and manufacturers of battery recharging units and coin meters. It will be up to the cities selected for the experiment to choose their partners.

Electric vehicle builders, as well as manufacturers of recharging units and of coin-operated systems are in a mood of expectancy. The government has just given a boost to electric cars by selecting 22 pilot sites instead of the 10 initially planned, as candidates to conduct field development testing. But the project is starting out with some confusion: Who will issue the calls for bids? Who will choose the manufacturers? Will diversity of local technical options be favored over collective experience at the national level?

One principle is being upheld at the Ministry of Industry and Foreign Trade: the idea is not to select one technology rather than another, but to test several approaches simultaneously. It is up to each city to implement the project for which it fought and to organize its own calls for bids.

EdF, which will assume a portion of the financing on a case by case basis, will have its say concerning the recharging units. Roland Wolf, EdF controller-general in charge of the electric car project, explains that "we will draw up our specifications and our calls for bids together with the sites. Candidates who are not selected but who participated in refining product definition, will have a chance to take part in an agreement procedure." This is a way of channeling technologies to some extent without sacrificing variety. But this agreement procedure will not be mandatory in any way. Any municipality will be free to turn to local enterprises!

In Douai, the gathering of documentation for the electric car has brought together local partners: the Renault plant; Etrad, which manufactures electric vehicles; DBT, which is working on recharging units... Will Grenoble be able to ignore the advances of an entity like Merlin Gerin? Will Bordeaux be able to forego collaboration with Saft, whose facilities are across the way from the mayor's office and its technical department? In fact, several municipalities have already formed agreements with manufacturers. Notably in La Rochelle, which has achieved pioneer status in the development of the electric car in France. At the end of next year, 50 PSA Peugeot Citroen electric cars, leased to private parties, will be running in traffic there. Westinghouse will provide the fast recharge units.

The American company was also selected by Lyon to equip the Stock Exchange parking lot with recharging units (slow ones in this case), linked to a remote control and billing station built by Innovatron. But the La Rochelle contract for slow recharge units is expected to go to a French company...

**France: Electric Vehicle Pilot Program Reviewed**  
*93WS0154B Paris LE MONDE in French*  
*29-30 Nov 92 p 24*

[Article by Roger Cans: "The Electric Car Slips into Town"; first paragraph is LE MONDE subhead]

[Text] Twenty-two pilot sites have been chosen for the implementation of an urban zero-emission vehicle network, but it will not be operational before 1995.

"It all depends on the municipalities. If they cooperate, there will be a multiplier effect. If not..." Senator Pierre Laffitte (RDE), former director of the School of Mines and an influential member of the Parliamentary Technological Options Bureau, observed at the Florence electric car show in September. In fact, although introducing the electric car poses technical problems with motorization and the battery, the practical difficulties of implementation and use are more serious.

There are no plans during the experimental phase to encourage the sale of electric vehicles to private citizens. The focus is on "base-bound fleets," like the liaison vehicles used by EDF [Electricite de France] (around 200 currently in service) or the municipalities (less than 600). "For me, the electric vehicle is short-distance transportation, a sort of extension of the public transit system," says Georges Le Roy, a representative for Electricite de France's marketing headquarters.

An effort is being made to sign up the local governments, which control the territory. The first agreement was concluded in December 1991 among the city of La Rochelle, the Peugeot-Citroen (PSA) automobile group, and the public utility. Why La Rochelle? Because the city of former environment minister Michel Crepeau has always sought to be on the leading edge in this field. It already has a fleet of 350 public bicycles divided among a dozen city locations. These bicycles, free in exchange for an identity card, provide inner-city transportation for drivers, who leave their cars in parking lots. So the principle has been established. Now simply installing battery charging stations will make it possible to supplement the bicycle-based system with a new, equally silent, zero-emission vehicle: the electric car.

Coincidentally, too, a La Rochelle company happens to have been producing an electric vehicle since 1991. This light-weight delivery van, called the "Volta electromobile," has a polyester body directly inspired by the hull of pleasure boats, a local tradition, and a Leroy-Somer motor, also local. The vehicle is assembled at former

Simca plant now owned by Ford. Already to date, over 100 Voltas have been sold to government agencies and communities.

### Fifty La Rochelle Volunteers To Receive "Electromobiles"

Under the three-way agreement, 50 electric-powered Peugeot 106s and Citroen AXs will be supplied to 50 La Rochelle volunteers for the year for a very modest charge. EDF will install around 100 slow-charging stations, for when the cars are garaged, and a few quick-charging stations, for emergencies.

These emergency stations will be installed only at service stations run by the Total oil company (which is also a partner in the operation) and public parking lots. There is a need for a modicum of precaution. Giving an uninformed public unrestricted access to heavy cables carrying thousands of volts is a tricky proposition.

Thus, the manufacturer supplies the vehicles, the electric company installs the stations, and the town provides for the maintenance and management of the fleet. If the experiment is conclusive, 300 vehicles could be placed at the disposal of La Rochelle residents by 1994.

The city of Tours plans to launch a similar program in 1994. Chatellerault, which has been using Renault vehicles (Masters and Expresses) since 1986, will be installing public stations, as will the city of Paris. Other communities already testing their own electric vehicles (Dijon, Dunkerque, Frejus, Monaco, Montpellier, Metz, Nantes, Saint-Germain-en-Laye, and Strasbourg) may eventually opt for the same scheme.

More limited experiments are attempting to test the various aspects of electric vehicle use in cities. In Nanterre (prefecture of the Hauts-de-Seine Department), EDF's customer service office has been operating a fleet of 25 electric Citroen C15s since the beginning of the year. If this experiment with use in a highly urban setting proves satisfactory, then the municipality will acquire electric vehicles for its own fleet.

In Toulouse, four Voltas have been added to the EDF conventional car fleet in order to test the integration of electric vehicles into a fleet of unmarked, computer-managed cars. Employees use either internal-combustion or electric cars according to the needs of the office. In Lyon, the city will be testing battery charging in underground parking areas with the EDF fleet (35 cars) and an initial fleet of 10 municipal electric vehicles soon to be placed in service.

Thus cities in France are tending towards two methods of using electric cars. The first, currently being implemented, favors the self-service car. An ad hoc magnetic card is used to borrow a vehicle from a public parking lot, and the vehicle is returned at another lot, where it is charged. This is "personal public transportation." The

other method, which should develop later, is the private electric car, which each owner would charge overnight in his garage or parking lot.

However, there are formidable obstacles to overcome in both cases. The self-service car will have to be carefully managed in order to satisfy all users. For example, how can the municipality insure that the cars available are always charged and ready to go? If not, they are likely to be abandoned where they stop or vandalized in the parking lot. As for the private owner, he will have to be required to lease his batteries, since the only way that the cadmium and nickel can be recycled is by returning the used battery to the supplier. Consequently, his "second car" will always be more "base-bound" than his first.

Nevertheless, manufacturers remain confident. "In 1995 we will be the first in the world to sell 3,000 town cars," according to Peugeot. Eventually, the electric car will be "necessarily cheaper than the internal-combustion car, given the technologies used." For EDF's "Mr. Environment," Jean-Pierre Bourdier, "an electric car is just a waterless water heater that consumes an average of 2,500 kilowatt hours a year." In other words, it is an extremely simple machine that is inexpensive to operate. Currently, charging a battery is equivalent to paying 1.20 francs a "liter" of electric fuel. And it is a fuel that the motor consumes only to produce motion, unlike the internal-combustion engine, which keeps on running when the car is stuck in traffic.

### [Box]

#### The Chosen Cities

The ministers of environment and industry had originally planned to carry out "10 full-scale electric vehicle pilot operations in 10 cities." However, given the number of cities applying to participate—almost 50—the number of test sites increased. "The originality of the proposals, the diversity of the local programs implemented, the participation of educational and research centers and manufacturers, and the different perspectives led the government to decide finally on 22 pilot sites," according to a joint communique issued Thursday, 12 November, by the Ministries of Environment, Industry, and Energy.

According to the ministries, the decision was based on specific criteria, such as the available power supply and the physical and financial resources the cities would need to acquire. Three cities and two sites will play a pioneer role: Chatellerault, La Rochelle, Tours, Saint-Palais (Belle-Ile Department), and Sophia-Antipolis.

In addition to the five pioneers, the other cities include Avignon, Bordeaux, Cherbourg, Douai, Grenoble, Le Havre, La Roche-sur-Yon, Lyon, Montigny-les-Cormeilles, Montreuil, Nanterre, Nantes, Nevers, Rouen (SIVOM), Saint-Quentin-en-Yvelines (associated sites: Versailles, Saclay plateau, site at Billancourt), and Strasbourg. The selection criteria seem not to have been purely objective or scientific. For example, the Peugeot

triangle of Montebelard, Belfort and Hericourt was probably chosen to please the automobile manufacturer. As for the choice of the Rouen metropolitan area SIVOM instead of the city of Rouen, the name of the intercommunal structure's president, Laurent Fabius, undoubtedly influenced the decision.

### **Germany: BMW's Slow-Speed Phase Converter Improves 6-Cylinder Engine Performance**

*93WS0189A Duesseldorf VDI NACHRICHTEN  
in German 11 Dec 92 p 22*

[Article by Olaf von Fersen: "Phase Converter Produces Power at Low Speeds"]

[Text] VDI-N, Munich, 11 Dec 92—Among the 6-cylinder engines being offered, BMW's construction series "M 50" is near top of the line. Meticulous precision work has markedly improved the engines.

BMW has improved its 6-cylinder engines through meticulous precision work. Both engines of construction series "M 50," having piston displacements of 2.0 l and 2.5 l, have been notably upgraded in a scrupulous model improvement program. The program resulted in a considerable improvement of the torque progression up to 10 percent in the  $3,000 \text{ min}^{-1}$  to  $4,500 \text{ min}^{-1}$  range, better idling quality, an 8 percent reduction in fuel consumption in the third-mix, and a 6-dB(A)-lessening of engine noise in the medium range. Everyone who operates the new engines will certainly find the reduction of the maximum torque speed from  $4,700 \text{ min}^{-1}$  to  $4,200 \text{ min}^{-1}$  a pleasing improvement.

Even before their upgrading, these Bavarian 6-cylinder engines were already among the small leading group in the powerful 6-cylinder engine category. They distinguished themselves by virtue of their good performance and high quality operation. In the spring of 1990, engines of construction series "M 50" received a double cam-shaft-cylinder head with 4-valve technology. Meanwhile, more than 500.00 units have already been sold.

To be sure, the basic concept of the 6-cylinder engine has not changed. However, one major innovation—the introduction of an adjusting mechanism for the inlet camshaft—and a number of scarcely noticeable changes added up to notable advances. The specific power ratings of 55.4 kW/l and 56.6 kW/l in the earlier models are still tops in the field. Consequently, there was no need to attempt to increase them. The modifications mostly pertain to three areas:

- measures to reduce friction losses.

- changes in the pistons and connecting rod;
- optimization and improvement of the valve drive through the introduction of variable inlet control.

The most important change bears the name "Vanos." The acronym derives from the words Variable Nockenwellen Spreizung (Variable Camshaft Kingpin Angle). As a mechanical accessory to the valve drive, it effects a controlled adjustment of the fixed opening and dwell periods in an area of a 25 degree crank angle. "Vanoss" offers advantages in wear, elasticity, quietness of operation, and emissions.

The concept of the "phase converter" is not new. It is used, for example, in reference to Alfa Romeo, Mercedes-Benz, and Nissan engines. BMW employs the advantages of valve control-period adjustment for the 2.0- and 2.5-l 6-cylinder engines, produced in series construction, as well as for the 3.0-piston displacement "M 3," which is specially equipped in this way by the Motorsport subsidiary. More power was also ordered for the M3 engine. The result was that it delivers top performance with its 210 kW and 320-Nm torque.

The reduction in friction was achieved through a number of small measures. The oscillating masses were reduced through the use of lighter pistons with reduced compression, which permitted the standard connecting rod previously used in the 2.0-l engine to be lengthened from 135 mm to 145 mm and in the 2.5-l engine from 135 mm to 140 mm. Thinner piston rings (1.5-mm thick for the two compression rings, and 2.0-mm for the oil ring) also contributed to the reduction in friction. Replacing the radial shock absorbers on the crankshaft with an axial absorber also had a favorable effect on the weight and engine acoustics.

The weight of the oscillating components of the valve drive could be reduced by changes in the cam stroke and the acceleration curve. The use of one instead of the previous two closing springs, the reduction of the valve shank thickness from 7 mm to 6 mm, and precision work on the hydraulic tappets were typical of the steps taken. Although each alteration was in itself minor, the aggregate of all the changes resulted in significant advances.

Both of the BMW 6-cylinder engines are equipped with digital engine electronics. In the case of the 2.0-l model, the electronics were supplied by Siemens (DME MS 40.1). The system used the previous year for some engine models, only needed to be expanded to accommodate the Vanos control. The mixture- and ignition controls used on the 2.5-l engine was supported by a Bosch DME 3.1. This is really an adaptation of the Motronic, which was developed for the new BMW 8-cylinders.

Characteristics of BMW 6-Cylinder Engines

BMW 6-cylinder	2.0	2.5
Bores/stroke (in mm)	80/66	84/75
Piston displacement (in cm <sup>3</sup> )	1991	2494
Compression	11.0	10.5
Power (in kW)	110	141
At speed of (in min <sup>-1</sup> )	5900	5900
Torque (in Nm)	190	245
At speed of (in min <sup>-1</sup> )	4200	4200
Camshaft	2	2
Valves per cylinder	4	4
Engine timing system	DME 40.1	DME 3.1
Injection	Cylinder selective	Cylinder selective
Ignition	Steady high voltage	Steady high voltage
Knock sensors	2	2
Fuel	Lead-free 95-91 ROZ	Lead-free 95-91 ROZ

Both engine timing systems operate with hot film air-mass meter, cylinder-selective injection, and steady high-voltage distribution in the ignition field. In addition, there is a cylinder-selective knock control, which permits an automatic adaptation to fuels of different quality. The power values are based on use of 95-ROZ fuel. If 91-ROZ is used as fuel, a slight loss in performance and fuel economy must be expected. The exceedingly precise mixture formation and the effective knock control provide the prerequisites for the relatively high geometric compression ratio of 11.0 and 10.5.

## BIOTECHNOLOGY

### Netherlands: Biotech Incentive Programs Considered Unproductive

93BR0297 Rijswijk BIONIEUWS in Dutch  
11 Dec 92 p 3

[Article by Richard Bezemer: "Innovation-Oriented Research Programs (IOPs) Look For Industrial Ties"]

[Text] IOPs [Innovation-Oriented Research Programs] work well as long as they have enough money. Once an IOP has ended, its stimulatory effect disappears too quickly. The retention of biotechnology knowledge and networks in industry after the IOP is over are the most important issues within the current biotechnology programs.

High-level university research, competitive applications, interested businesses, an efficient consultative structure, and a purse full of money. It was almost impossible for the Biotechnology IOP (IOP-b) to fail.

Even so, two years after the ending of this IOP, those concerned are feeling somewhat disappointed. The stimulation of basic research and the development of application-oriented research programs have, it is true, had a

positive effect. Since 1981, five university centers for biotechnology have been set up. University research has received an extra stimulus of 110 million Dutch guilders, i.e., the equivalent of 1,130 man-years. An evaluation commission assessed the quality of the research as good. But the eight-year stimulation program has not led to a continuing intensive collaboration between the academic and business communities. Projects have been correctly finished and that has been the end of it. The very carefully built up biotechnology network has, from this point of view, been too noncommittal and has too often been limited to pleasant greetings exchanged at receptions and meetings.

On 26 November there was yet another similar chance to shake hands at a workshop organized by STIPT [Organization for the Implementation of Technology Policy] entitled "Biotechnology in Your Business." Its subtitle was: "Can the IOP incentives contribute to the strengthening of your competitive position?" The answer to this is "yes, if the knowledge transfer is continued, if the network which resulted from the IOP can be maintained and extended, and if the knowledge gained can be implemented by industry."

From presentations on the four current biotechnology-related IOPs—Carbohydrates, Catalysts, Environmental Technology, and Industrial Proteins—it seems that the policy makers have in this respect learned something from IOP-b. From the earliest stages of the current IOPs, there have been intense discussions on how the future structure between researchers and industry can be maintained.

### Noncommitment

According to PhD. Cand. A.J.M.M. Maes, chairman of the IOP steering committee, the reason for this poor continuation lies in the lack of responsibility of the

participating companies. They do not need to pay anything but are expected to do something with the results.

Business involvement can be increased by allowing companies to formulate their research needs clearly. Disappointment on the side of both donor and recipient can be prevented by providing clear plans for future applications and potential users of the research to be carried out. Dr. Eng. J. Oelderik, chairman of the Catalysts IOP Program Commission, expresses this as follows: "There is a big difference between digging a hole in Purmerend and building a mountain in Den Bosch, but in fact you are doing the same thing in both cases: moving a large amount of sand." It is also possible to secure greater "commitment" from companies by allowing them to participate actively in the development and management of an IOP. This can, however, cause friction among university researchers who would prefer to remain independent. They will not accept that their research activities be controlled by ministries through direct or indirect subsidies for applied research, i.e., a kind of obligatory contract research.

### Research Schools

Eng. J.E. Veldhuyzen of NIABA [Netherlands Industrial and Agricultural Biotechnology Association] thinks that research schools can play an important long-term role in the continuation of the networks. These "bastions of high-level research" are more easily accessible for companies; their research is much less fragmented.

Researchers must, however, gain more insight in the problems which businesses come up against. It is not always a simple matter of finding an ingenious answer to a difficult process. The heartfelt cry of Dr. A.A.M. de Laat (Vander Have company) speaks volumes in this respect. In his opinion, scientists must be more involved with questions concerning the safety of [genetically] modified products. The business community is already in the suspect's seat in this area. "It must be able to demonstrate that a transgenic tomato is healthy, whereas this cannot be done even for a normal tomato!"

### Good Example

The Carbohydrates IOP, developed under the leadership of Prof. H. van Bekkum, which comes to an end in the middle of 1993, shows a fruitful connection between research and industry. Industry has contributed 3.5 million guilders to this IOP. Furthermore, the continuation of this IOP has been guaranteed by the foundation, on 1 April, of the "Carbohydrates Foundation."

Continuation of this policy is necessary, because the eight-year intervention via the IOP is too short to carry out all plans. This was made clear through the Biotechnology IOP.

## DEFENSE R&D

### France: Defense Robotics Research Projects Described

*93WS0183A Paris PRODUCTIQUE/AFFAIRES  
in French 5 Dec 92 pp 5-7*

[Article by Alain Chene; untitled]

[Text]

### Mobile Robotics in France

With around 30 companies and more than 10 years' experience, France is the European country most heavily committed to the development and construction of civil and military mobile robots. All applications of mobile robotics tend to share common functionalities: forward movement, trajectory optimization, relative and/or absolute localization, management of environmental knowledge, sight, reasoning, planning, and grasping objects. Various aspects—powering, materials, communications, computer architecture, integration, supervision, programing, and simulation testing—define the technical boundary below which the mobile robot is not a robot and beyond which all research efforts are focused. Because of its numerous players in this field, France is in a position to meet these technical challenges. To do so it must necessarily take into account a number of parameters: cooperative synergies, rationalization of spending, and the pooling of investment and know-how. Today, robots are still the inspiration of great technological and economic ambitions for tomorrow. In the civilian sector, they will clean the subway and the buses, monitor buildings, pick fruit, distribute meals in hospitals, and pick up nodules. Several applications are already a reality. In the military sector, the possible applications for mobile robots are becoming better and better defined. On the ground, they will be able to intervene in an offensive capacity, as assault troops, or in a defensive capacity, as antitank or antipersonnel-mine tools, or, from the logistical standpoint, as detectors of chemical or bacteriological attacks or distributors/transporters of food, medicine, and munitions. Aerial robots (or drones) will carry out surveillance, jamming, attack, and communications relay missions. Underwater robots will be used not only for minesweeping and torpedo recovery but also for transmissions monitoring, observation, recording bathymetric measurements, and as antitorpedo decoys. Both civil and military mobile robots are currently up against the same technological barriers: autonomy, intelligence, and, more specifically, stealth (discretion, agility, bulk). The approach taken to resolving these difficulties is open-ended. The first step is to develop the robot's ability to perceive its state and that of its environment, after which it must be given a navigational strategy. The imminence of consumer markets and the now unavoidable advent of military robots compels us to be far-sighted: we will face a need for methodology and a means of certifying these robots. Together, DRET [Directorate of Research, Studies, and

Technologies] and the civilian sector could establish a testing and certification center that would be unique in the world. It would serve to ensure the safety of these new machines that will work among the public and perhaps also to define, measure, and standardize a robot's artificial intelligence and autonomy of decision.

#### Some Sample Applications: DARDS and Protectron

As research coordinator, DGA/DRET [General Directorate for Armament/Directorate of Research, Studies, and Technologies] heads the DARDS [High-Speed Displacement Autonomous Demonstrator for Surveillance] program. The main French companies on the leading edge of civilian mobile robotics are participating in DARDS, which has a 19-month budget of 30 million French francs [Fr]. It consists of a ground station and a mobile base (a four-wheel-drive jeep) which is being progressively refined to carry out the surveillance missions assigned to it more effectively on an autonomous basis. The DARDS program is halfway between research and application. Consisting of three main phases, it has a specific technological script leading to the creation of an intelligent, communicating autonomous robot capable of carrying out its surveillance mission at high velocity (up to 80 km/hour) on all terrains. For its part, SEFT [Telecommunications Research and Manufacturing Section] is interested in teleoperation, aspects specific to communicating information to the remote pilot, and ergonomics. It and the companies Giat Industries, ECA, and Itmi are carrying out a medium-term program entitled Protectron, an explicit acronym for Economical Teleoperated Robotized Platform for Firing, Reconnaissance, Observation, and Neutralization. This program began in October 1991 and will continue until February 1993.

#### Cartography for Mobile Robots

In order to orient themselves and carry out their missions, the first mobile robots (dating back 15 years) systematically explored everything they encountered using a strategy that, while certainly progressive, was tedious at the very least. Thanks to advances in computer science, robots increasingly rely on their memories, which are fitted with sets of boards containing the topographical and functional information necessary for them to find their way. A robot with a cartographic database can go to room 735 of a multistory building directly via the eighth floor, north wing, for example. Its ancestors would have explored each of the 30 rooms per floor and climbed the floors one by one until they reached the final goal.

#### SAATMAS: Mobile Robots for Meeting Aircraft

At every airport, even after the airplanes have landed, they still consume a large amount of fuel (creating chemical and noise pollution) and use their brakes and engines to reach their final parking places. The SAATMAS [Automatic System for Insuring All Aircraft Ground Movements] project, filed by Aerospatiale,

describes an automatic system of accomplishing all aircraft ground movements with mobile robots. Two robots are required for each airplane. The first, a lightweight autonomous robot, meets the aircraft in order to couple with its landing gear "on the fly." The second, which is considerably heavier and more powerful, then joins the first robot, to which it connects using its swiveling, extendable arm. Once it has been met and coupled, the plane cuts its engines and becomes passive. The tractor robot, which has received parking information by computer, tows the plane to the gate.

#### FIRST: Robots in Hospitals

In three years at the latest, the Grenoble firm Itmi will unveil the industrial prototype of its FIRST (Friendly Interactive Robot for Service Task) [as published] autonomous mobile robot. A EUREKA-label [European Research Coordinating Agency] project with a budget of about Fr33 million, FIRST will transport meal trays, keep each service in clean linens, and distribute medical supplies. Unlike the current automatic vehicles confined to technical bays, it will be able to move freely about the hospital, aided, if necessary, by one or more "fellow workers," without requiring any changes in the existing infrastructure.

#### Driving an AMX 32 With a Joystick

An AMX 32 weighs around 40 metric tons, has an 800-horsepower engine, and can travel at up to 65 km/hour. Its manufacturer, Giat Industries, has succeeded in making it possible to drive an experimental model of this machine with a simple joystick. A computer installed between the driver and the controls translates the different movements of the joystick into acceleration, activation of engine breaking, and breaking. A push button triggers a U-turn in place, and a direction-reverser allows the driver to back up. The goal of this study is to validate the reduction of the number of operators on board. It is an important first step towards both the automation of driving and remote control.

#### Marula, the New-Generation Aerial Robot

Employed since the Vietnam War, the first U.S. and Israeli aerial robots (or drones) recently demonstrated their usefulness again. In France, SAGEM (Company for General Applications of Electricity and Engineering) and the A&S company are developing Marula, a new-generation aircraft designed to carry out a variety of missions, including detection, attack, jamming, and target acquisition. Halfway between an aircraft and a missile, the Marula drone has successfully completed two series of tests since 1989. It will now be fitted with electronic automatic-navigation equipment in order to give it greater autonomy. With a wingspan of 2.24 m and a length of 2.11 m, this drone provides a range of 400 km and two-and-one-half hours of autonomy. Rocket-propelled on takeoff, it flies at a cruise speed of between

180 and 250 km/hour. At the end of its mission, Marula heads to a recovery zone, cuts its engine, and parachutes to earth.

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## ENERGY, ENVIRONMENT

### **German Bioreactor Converts Organic Waste Into Fuel**

93WS0123A Duesseldorf WIRTSCHAFTSWOCHE  
in German 23 Oct 92 pp 56-59

[Article by Thomas Mnchner and Wolfgang Kempkens]

[Text]

#### **Waste Management—Biogas and Potting Soil**

Organic waste develops into a high value fuel in reactors. When the 250,000 residents of the area of Helsing/Fredensborg-Humlebaeck throw their food scraps, grass clippings and potato peelings not onto the backyard compost heap but into a trash bag, they even feel good about it. Their bio-waste—some 20,000 tons per year—are not put into a landfill or burned, but will be usefully recycled in a biotechnical installations and converted into energy-rich biogas and a type of potting soil.

The price for this installation is 20 million German marks [DM] paid for by the Danes. Experts say this is showing the way to a better age for waste management. The system was developed by Biotechnische Abfallverwertung GmbH & Co. KG (BTA) in Garching near Munich, whereby the company runs a large test installation at its headquarters. According to the manager Gerd Mulert, the break-through may have been reached now. "Every week we receive up to four groups of visitors who want to learn about our technology," he states with pleasure. In Aachen, Landsberg and in the districts of Munich and Freising/Erding, the women and men of the Council discuss with their administrations the installation of bio-reactors for waste management. In Nuremberg the decision has already been made. Mller Abfalltechnik GmbH (MAT) in Stuttgart, a subsidiary of the specialist for water technology, Philipp Mller GmbH & Co. and the French Degremont, which has acquired a BTA license, received the order for the construction of an installation with a capacity of 25,000 tons per year. MAT manager Richard Frick sees a quite rosy future: "Within two years we shall have sales of at least DM40 million from BTA reactors." Better waste management is demanded worldwide. The construction of an installation will begin shortly in Canada. Mulert of BTA is also calculating his chances in other European countries. Talks regarding his "Mercedes of waste management," as he proudly calls his system, are under way, e.g., also in the Netherlands, Scandinavia and France. Biological waste management was born in May 1983. At that time,

13 environmentally aware engineers, chemists and business people founded the Society for the Recycling of Energy and Waste (REA). Their goal was the development of a bio-reactor which would convert organic wastes into methane and compost, and in an economical manner. However, in the beginning it was hard to get money. "People who were creatively involved with waste management were then considered alternative nuts," states Harry Wiljan, founding member and co-manager of the current BTA, with a smile. A tax consultant finally had the idea. He recommended to the young idealists to form a limited partnership and to look among environmentalists for sponsors. Within two years, 380 sponsors for BTA, the successor to REA, were found, who brought together almost DM4 million. "We did not want any large investors, in order not to become dependent on them," according to Mulert. The collected funds were enough to develop the technology and to build a demonstration plant. However, the chosen type of financing was not the only key to success. According to Wiljan and Mulert, the unconventional alternative organization of the company was just as important. All employees, there are now 20, have equal rights and equal pay—there are child supplements—and participate with equal shares in the capital of the company. Important decisions are taken by consensus. In 1990 the harmonious team appeared to have it made. McDonalds, the Big Mac supplier, wanted to use the Garching technology for their waste management. However, no decision has yet been made, although talks have not broken off. Only with the decision by the Danes came the first real income. The Garching share of the installation brought DM3 million. For this project BTA profited from the experience gained from the numerous tests with McDonald waste. In a first step, the organic waste is partially dissolved in a large vat filled with water. Waste of synthetic material will swim to the top and is skimmed off. This separation is exactly what Denmark also wanted. There, organic waste is collected in plastic bags. "In spite of all the care taken, it keeps on happening that synthetic scraps show up again in the compost," laments Mulert. He prefers that these waste materials are collected in bio-barrels, as it is already customary in many European countries. The unappetizing mush from the vat is then pumped into a bio-reactor, in which bacteria convert the dissolved harmful substances into biogas, primarily methane. After this procedure the water is cleaned to the extent that it can be treated further in the adjoining waste water treatment facility. For the remaining solid materials Mulert and his gang have devised a special torture. They wind up in a high-performance reactor in which a carefully selected mixture of micro-organisms breaks down even the toughest molecules. What remains is an easily compostable mass which can soon be used as potting soil. The high-performance reactor also produces biogas, which can be used for energy or heat production. The same process occurs in landfills. But, even with careful suction, a large part of the gases escape into the air. There they contribute to the heating of the earth atmosphere. The gas from the bio-reactors, however, has a positive climatic effect. It replaces a corresponding

quantity of other, mainly fossil fuels, such as coal, oil or gas. And the carbon dioxide, another climatic gas, resulting from the burning of the biogas does not cause additional damage. The biological waste has drawn it out of the air previously.

### Germany: Process To Remove Heavy Metals From Waste Water

93W'S0126C Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 16 Nov 92 p 10

[Article by JB: "Heavy Metals Removed in Column Filter; Calcium Ions Replace Problem Metals in Slightly Polluted Waste Water"]

[Text] Frankfurt—Heavy metals can now also be efficiently removed from slightly polluted waste water. For this purpose, Professor Dr. Walter Franke and Dr. Reinhard Ballhorn have developed a column-filter process at the Free University of Berlin's Institute for Mineralogy (Takusstrasse 6, 1000 Berlin 33). It could be especially useful for waste water produced in ore dressing, electroplating, and at car-wash installations, as well as for water seeping through the ground from dumps and waste water from recycling processes containing less than 10 milligrams per liter of heavy metals. The Berlin process has proven to be particularly effective with the problem metals: cadmium, copper, lead, and chromium. The levels of pollution after treatment were equivalent to those prescribed for drinking water or even lower than those.

The basis of the process is the reaction of heavy metal ions in waste water with amorphous calcium phosphate. When this occurs, not readily dissolvable heavy metal phosphates are formed. The amorphous calcium phosphate is produced by soaking a pebble-gel carrier with a calcium hydroxide solution followed by the addition of a phosphate solution. An equivalent number of calcium ions is dissolved for every heavy metal phosphate that is formed. However, calcium is completely harmless, ecologically and in terms of people's health.

In principle the process operates like an inorganic ion-exchange process. But the advantage over conventional ion exchangers lies in the fact that the latter are not cost-effective with low concentrations of heavy metals. Another characteristic of the Berlin process is its ability to withstand neutral salts and high operating temperatures.

The plant consists of several glass columns which contain the modified pebble gel. The waste water is fed to them by pumps.

A pilot plant has been operating since early 1992 in collaboration with a Lower Saxony firm and with financial aid from the State of Lower Saxony. The column capacity amounts to 200 liters. This plant requires an investment of DM30,000 to DM40,000. It costs about DM500 to recycle a column content of 25 liters. But with water containing more heavy metals, Franke recommends pretreatment of the waste water.

### Germany: Microbes Used To Liquefy Coal

93W'S0126D Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 5 Nov 92 p 8

[Article by BH: "Microbes Can Liquefy Coal; Pilot Plant Expected To Go Into Operation in Italy Before Year End"]

[Text] Frankfurt—In the opinion of R. Fakoussa of the University of Bonn's Institute for Microbiology and Biotechnology, the liquefaction of coal with the aid of bacteria and molds should be a technologically interesting alternative to the conventional ways of making coal accessible. A first pilot plant is expected to go into operation in Italy before the year is out, at which they should come up with a coal slurry with the aid of microbial surfactants in combination with microbial desulphurization.

It has been known for 10 years now that coal can be decomposed microbically. Before, it was thought that it is impossible for the water-repellent carbon structure, which arises not biologically but physicochemically, to be attacked by organisms. But it has been shown that some soil bacteria and molds form enzymes that can split the structures of the different kinds of coal. Moreover, microbial surfactants break off tiny particles of coal so that a coal slurry with a concentration of given coal components can be produced microbically.

As expected, brown coal with its loose structure decomposes microbically more easily than does hard coal, which because of its compact structure makes it difficult for the microorganisms to gain access to its tiny cavities. The microorganisms liquefy the coal essentially by means of three mechanisms: alkaline substrata, oxidative enzymes, and the formation of chelates.

Alkaline microbial liquefaction is far inferior to chemical liquefaction. However, the liquefaction of brown coal by enzymes, that is, by the phanerochete cryosporium mold, seems interesting to researchers. As can be shown in laboratory testing, the mold is capable of completely liquefying the coal. This results in carbons rich in hydroxyl and carboxyl groups.

**Germany: Progress in Growing Plants for Alternative Fuel**

93WS0134B Duesseldorf HANDELSBLATT in German  
24 Nov 92 p 7

[Article by HJS: "Renewable Raw Materials: Specialized Agency Expected To Coordinate Marketing as of 1993; Research Minister Riesenhuber Feels That Threshold of Cost Effectiveness Has Been Reached"]

[Text] Bonn, HANDELSBLATT, 23 Nov 92—Renewable raw materials will, at this time, only be grown on a surface area of 210,000 hectares. Emphasis will be laid on starch and rapeseed oil.

Minister of Research Heinz Riesenhuber made this statement when he submitted his interim report on research and development operations in the field of renewable raw materials.

According to available estimates, an additional 200,000 to 750,000 hectares of farmland could, according to Riesenhuber's statement, be used for the production of plants for industrial use by 2005 because of a growing demand for them. The minister expressed the opinion that renewable raw materials such as flax, rapeseed oil, and starch obtained from agricultural products will now be reaching the market in growing numbers.

It follows from a study on the subject of renewable raw materials submitted by the Ministry of Research that rapeseed oil and rapeseed methyl ester have reached the threshold of cost effectiveness as substitutes for diesel fuel from the standpoint of individual cost effectiveness. Riesenhuber feels that paying for a given subsidy with public funds for the employment of renewable raw materials as sources of energy is justified provided that it entails a reduction in pollution of the environment.

It is anticipated that there will in future be close contact between farmers and industry to bring products made from renewable raw materials onto the market by laying emphasis on more consultation and marketing activities. This will be one of the chief missions of the new specialized agency that is to be established in the Ministry for Food, Agriculture, and Forestry (cf. HANDELSBLATT, 17 Nov 92). Therefore, as of the beginning of 1993 the Ministry of Research will turn responsibility for research and development in the field of renewable raw materials over to it. Basic research [in this field] will, however, continue to be conducted by the Ministry of Research.

The limit to cost effectiveness with the employment of vegetable oils and methyl ester determined in the above-mentioned study is, among other reasons, based on the fact that they are not at present subject to the tax on mineral oils provided that they are not mixed with mineral oil products. The tax rate for diesel fuel produced from mineral oil is at present 54 pfennig a liter. Since the study was completed, a resolution has been drafted by the EC Commission that provides for tax

advantages for vegetable oil additives that are comparable to fuels. In the study, however, they also say that the tax advantages for diesel fuel or gasoline obtained from renewable raw materials would at the same time mean less revenue for the state, losses of revenue that could amount to three-figure millions within a few years and add up to the detriment of the national economy.

From the standpoint of individual cost effectiveness, the road to cost effectiveness for the individual sources of energy from renewable raw materials is still a long one because the competing fossil energy sources: coal, fuel oil, and natural gas, would not be taxed or only be taxed at low rates. Consequently, a tax waiver would not improve their competitiveness to the extent it would that of the liquid energy sources that replace diesel fuel or gasoline.

**France: Environment Minister Promotes French Industrial Know-How in Eastern Europe**

93WS0180B Paris LE MONDE in French  
13-14 Dec 92 p 13

[Article by Roger Cans: "Mrs. Segolene Royal Promotes the Know-How of the French Environmental Industry"; first paragraph is LE MONDE lead]

[Text] From 6 to 9 December, the environment minister, Mrs. Segolene Royal, visited Czechoslovakia and Poland, where French companies are attempting to contribute their know-how to repair environmental damage.

Bratislava—Contrary to diplomatic custom, Mrs. Segolene Royal chose to begin her European tour with a city that, while not yet a capital, will become one on 1 January: Bratislava, the future capital of the Slovak Republic. Why go to Slovakia first? Because, in the area of environmental cooperation, French companies have a better chance in this still very isolated region of Europe than in Bohemia, which is too intensively courted by Germany. The Slovak government did appear extremely flattered to be the first in Eastern Europe to receive French offers of cooperation. Mrs. Segolene presented her hosts with an array of companies and agencies ready to proffer their assistance to the Slovaks.

The Bureau of Geological and Mining Exploration (BRGM), for example, proposes to study Slovakia's geothermal potential, which is of particular interest to the environment minister, Mr. Jozef Zlocha, a geologist by training. The Nuclear Protection and Safety Institute (IPSN) has signed a nuclear safety agreement in the event of a serious accident at one of the four Bohunice reactors or the two reactors nearing completion in Mochovce. Fifty-four percent of Slovakia's electricity is nuclear, produced by Soviet-designed VVER reactors often contested by its citizens. Saint-Gobain Nucleaire (SGN) has proposed a waste management plan for Bohunice nuclear wastes. Compagnie Generale de Chauffage is working on a proposal for a plant to burn Bratislava's household garbage, and SAGE Services is studying the pollution of Danube tributaries.

The only subject that has not been broached officially is the giant Gabcikovo dam on the Danube, which is to supply 720 megawatts at full power. Its first two turbines were recently started despite the fierce opposition of its Hungarian neighbors. France does not want to get mixed up in a diplomatic dispute that, in any case, does not involve French industry, since the turbines are Austrian and the civil engineering is shared among Slovakia, Hungary, and Yugoslavia.

#### Operation "Clean Prague"

Mrs. Royal instead chose to visit the huge Istrochem chemical complex. Founded 120 years ago by Alfred Nobel for the manufacture of explosives, it is in urgent need of modernization. The only progress on reducing pollution has been made by "liquidating" obsolete production units or, in other words, by appreciably decreasing production and employment! In Ostrava, the iron and steel capital of Moravia, now stricken by restructuring, Mrs. Royal promised a package of 2 million French francs [Fr] from her ministry, which will come in addition to the Fr14 million already promised by the EC.

The welcome was much cooler in Prague, where the environment minister, Mr. Frantisek Benda, is obviously counting much more on his German neighbors in Bavaria than on France to help him clean up the problem spots in the Czech Republic. Only the mayor of Prague, Mr. Milan Kondr, appeared interested in the operation "Clean Prague" proposal prepared jointly by Gaz de France, Generale de Chauffe, and Charbonnages de France. Financing the cleanup of city's atmospheric pollution solely through energy savings in the network seemed like a good idea to him....

In Poland, where French environmental industries gained a foothold during the tenure of Mr. Brice Lalonde (LE MONDE, 23-24 Sept 90), Mrs. Royal was able to see the "ecological solidarity" dear to her already at work in Gdansk, where Mr. Olivier Bouygues's Societe d'aménagement urbain et rural (SAUR) will be installing a water treatment plant capable of treating the entire city's waste water.

Her Polish interlocutors, starting with the environment minister, Mr. Zigmund Hortmanowicz, all called for an acceleration of "eco-conversion," that is, the reduction of the Polish debt to France (Fr5 billion) in exchange for environmental investment. Mrs. Royal said that France agreed to convert 1 percent of the Polish debt to "ecological investment" provided that Warsaw produced a list of priority projects.

#### German Technical College Presents Two Alternative Energy Systems

93M10210 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 18 Nov 92 p 2

[Text] After five years of applied research, the Wiesbaden Technical College wind energy project is now in a position to present two wind converter systems with unprecedented efficiency levels.

This makes exploiting wind energy not only an ecological, but also an economic proposition, even inland. The two leading models, which emerged from the initial wide range of rotors investigated, are the multiblade turbine (slow runner), with more than 35 percent efficiency, and the Darrieus rotor, with more than 40 percent efficiency. According to Professor Winfried Schatter, the wind energy project leader, the ultimate maximum performance has still not been achieved. Present findings suggest that improvements of about 50 percent can be expected with the Darrieus rotor and about 40 percent with the multiblade turbine.

#### Breakthrough Achieved

The breakthrough for using inland wind power stations for the 5-20 kilowatts nominal output range has thus clearly been achieved, as is confirmed by the considerable number of potential joint venture partners in industry and local government. As well as their level of efficiency, both converter systems have an excellent self-starting capacity, which is another point in their favor. The Darrieus rotor works at wind speeds of four meters per second and above, while the slow runner cuts in automatically even at two meters per second. Another very important feature is that the models are competitive to build and can be adapted to take account of local conditions. This means that they can be successful on the market as a, so to speak, "natural" alternative to offshore wind farms, which are different in size and whose design is not at all simple to adapt to inland conditions.

#### The Combination Solar Filling Station

As a special potential application for wind energy, the Technical College project also developed a bivalent solar filling station for electric vehicles to supply electricity via both wind and solar generators. The energy can be produced by wind farms outside towns and by solar systems, for example on the roofs of tower blocks. Professor Schatter called on town councils to take action to achieve the aim of halving CO<sub>2</sub> emissions by the year 2000, citing Ruesselsheim, which is about to install a municipal solar filling station, as an example.

## FACTORY AUTOMATION, ROBOTICS

### **Germany: High-Speed Electron-Beam Drilling**

93WS0126B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 13 Nov 92 p 8

[Article by SCHA: "Extremely Small Holes Drilled With Electron Beam; Up to 3,000 Holes per Second Drilled; Small Holes Create Laminar Flow"]

[Text] Frankfurt—Alongside high-tech welding systems and the processing of surfaces with electron beams, the Frankfurt firm Messer Griesheim, Ltd., has also further developed the electron-beam drilling process, by means of which, thanks to modern [computer] control technology, it is today possible to drill up to 3,000 holes per second. With it, nearly all metallic and some ceramic materials, even high-strength cobalt alloys with which conventional methods do not work, can be processed. The diameter of the hole ranges from 40 micrometers to more than a millimeter.

According to its own statement, Messer Griesheim, the only supplier of this state-of-the-art technology, is at present testing the electron-beam drilling of small, microscopic holes in the wings of future aircraft. By suctioning up troublesome eddies, the layers of air flow evenly over the wing surfaces. It is anticipated that fuel consumption can be cut by as much as 20 percent with this kind of laminar flow control. Twenty-four European partners—aircraft manufacturers, aeronautics institutes, and suppliers, as well as universities—have joined forces under the direction of German Airbus in the European Laminar Flow Investigation (ELFIN) project.

Mass-produced components made of thermally high-strength alloys already acquire their final surface structure in the electron-beam drilling vacuum chamber. For example, the electron beam drills the 3,748 holes of the combustion-chamber housing with a diameter of 0.9 millimeters and does so at a variable angle of inclination. It also drills the holes in turbine blades for cool-air flow. In comparison with alternative production methods like spark erosion or electromechanical drilling, the electron beam reduces production costs for the mixer disk of a helicopter power unit by about 50 percent, according to the company.

Electron-beam systems are used in the food industry to drill holes in the hardened steel of the grinding disks of meat grinders. Rock wool and fiberglass are produced with the aid of spinnerets made of extremely hard, high-heat-resistant cobalt alloys. The electron beam drills the 256,000 holes necessary for these spinnerets in 16 minutes, in the course of which the wall strength of the spinneret may vary between 3.3 and 5.5 millimeters and holes from 0.6 to 0.7 millimeters in diameter are required.

In comparison with this, it takes a solid-state laser 213 minutes to drill the same number of holes with a uniform

wall thickness of 3.3 millimeters. In the paper industry too, which is increasingly employing waste paper, millions of holes are drilled with an electron beam in the filters for the new drainage rollers of the recycling process. The high number of holes an electron beam can rapidly drill, as many as 3,000 a second, is due to the effective interaction of beam deflection, alignment of workpiece movements, and computer-numeric control, EBCON, with extremely rapid data processing. A data bank that is available to Messer Griesheim also provides information on special applications.

### **France: Technology Transfer Center Promotes Rapid Prototyping**

93WS0133A Paris TECHNIQUES ET EQUIPEMENTS DE PRODUCTION in French Nov 92 pp 30-32

[Article by Marie Cadilhac: "Prototyping: A First in Le Mans"; first paragraph is TECHNIQUES ET EQUIPEMENTS DE PRODUCTION subhead]

[Text] With the first French application of Cubital's stereolithography system, rapid prototyping has entered a new era. A technological challenge from the computer-integrated manufacturing department of the recently established Technology Transfer Center in Le Mans.

In comparison with the conventional laser stereolithography processes now available on the French market (3-D Systems' SLR machines and, more recently, EDS's [Electronic Data Systems] Stereos system), the Cubital technology opens new vistas. Behind its machines' reputation for complexity lies a process of another kind, based on UV [ultraviolet] polymerization, which offers a number of non-negligible benefits. It has two primary distinguishing features: high-speed polymerization by flash UV exposure through a mask and the use of wax, which, by filling in the spaces outside the parts, maintains the models in a solid environment. The advantages? No part supports during the process, no shrinkage or distortion of the models, and no post-processing. Better still, this technique, called "solid ground curing," enables the simultaneous production of several prototypes. It lends itself well to the fabrication of parts with very complex shapes and geometries (closed volumes, for example) that are practically impossible to produce with traditional modeling methods. It also offers the possibility of designing groups of non-contiguous parts such as bearings. All these advantages led Jean-Claude Tasse, head of CAM [computer-aided manufacturing] activities at IUT Genie mecanique [University Institute of Technology for Mechanical Engineering], Le Mans, and the other prime movers behind the production department (including various manufacturers) to opt for this process. To date, the technique has been used primarily in the United States (six machines) and, recently, in Europe (fifth installation). This approximately 3 million French franc [Fr] investment is the centerpiece of a more general strategy aimed at providing full concurrent engineering services.

### No Shrinkage or Distortion of Parts

To go from the CAM model to the functional model, the computer-integrated manufacturing department also uses three-dimensional CAM software (Strim 100, Ideas, Pro Engineer), a Jo Tech high-speed five-axis mill specially tailored for the reworking and fabrication of prototype models, and structure and rheology calculation programs to assist in designing the molds.

The new Le Mans center's primary goal with these resources is to transfer this new rapid prototyping technology to manufacturers in France, if not Europe. Rather than just producing parts, it would like to cover the entire process validation aspect. Operational for barely a month, the team in charge of the Cubital installation (three technicians) has already completed some 10 customer parts. Of the first businesses to begin working with the Le Mans center, both Valeo's "internal-combustion/body" division and Philips Data Communication note its (quickly acquired) high level of competence and its rapid response time. One of these exemplary products is none other than the heating and cooling system housing for a vehicle designed by the auto manufacturer. Valeo, which plans to implement rapid prototyping, is currently evaluating the various processes, including Cubital's.

However, the Technology Transfer Center's activities involve not only the big industrial principals but also companies specializing in concurrent engineering, modeling, or tooling. "In order not to bypass these subcontractors, we are prepared to establish advantageous partnership activities with them," center director Jose Grevin says. Like most rapid prototyping systems, the Cubital process works by fusing layers of a constant thickness of 0.015 millimeter.

One or more parts can be produced side by side on a 500 x 350 x 500 mm capacity supporting table. Thin layers of resin corresponding to the sections of the part are hardened sequentially by polymerization. However, there is no laser-beam sweep. Once a layer of liquid resin has been deposited, it is subjected to a brief (five-second) initial flash of high-intensity UV radiation through a mask. The non-polymerized resin (the volume outside the part) is then evacuated by suction. A second, 17-second UV exposure insures that the polymerized layer is well cured. Next, wax is deposited in the empty space. The layer is hardened on a cold (6°C) supporting table and then corrected by machining before the next layer is deposited. The cycle currently lasts 90 seconds, regardless of the type and number of parts formed. This time will soon be reduced to one minute, thanks to the creation of a second UV radiation station.

Simultaneously, the mask for the next layer is being generated in another cycle. The mask is made using iconographic techniques from electrostatic powder on a treated glass surface. On completion, the wax is removed simply by washing the parts in warm acidulous water.

### High Quality, Precision Models

This type of process offers a high level of productivity. Comparative tests conducted by the U.S. manufacturer Chrysler show the Solider 5600 system to be at least 22 times faster than the competing laser machines. Moreover, with this technology, fabrication time is not proportional to part size. To optimize production times, the Le Mans Technology Transfer Center plans, among other things, to group flat parts. This will reduce fabrication height and cut some times in half—from four to two days for certain parts such as car radio frontal housings. The manufacturer Cubital, which does its calculations on a volume basis instead of per part, computes the cost price of a liter of shaped resin at around Fr7 thousand.

One of the major advantages in the eyes of some of the Technology Transfer Center's leading customers is the quality of the models. The precision obtained is approximately 0.1 percent, or a deviation of one-tenth millimeter per 100 linear millimeters. Their mechanical strength appears excellent. For Philips DC [Philips Data Communication], which recently subcontracted fabrication of the same part using the two technologies, the situation is clear-cut. From the dimensional, structural, and mechanical standpoints, the Cubital process produced the best results. Pascal Bru, head of industrialization research for Valeo Thermique Habitable [Valeo Internal-Combustion/Body], sees fewer differences, although he says, "the wax-based technology provides parts with better mechanical stability."

In addition to working in a solid environment, non-laser stereolithography enables the use of a very low-shrinkage resin. This limits in- and post-process deformation. The acrylate resin used in this process (a Coated Brothers product) has mechanical properties similar to ABS [acrylonitrile butadiene styrene]. It is non-toxic and withstands temperatures of up to 60°C.

Applications for the parts obtained mostly involve product evaluation (dimension checks, function checks, etc.) using a precision model or a reproduction of the parts produced by vacuum molding.

The Le Mans team intends to push ahead by developing the metalization of the resin models. In the future, it also plans to employ resins that will produce prototypes suitable for the fabrication of molds by the lost-wax process.

Processing of CAM data prior to transfer to the computer in the Solider 5600 machine is very similar to competing systems. The only major difference in this preparatory phase is that it does not include the creation of supports.

Working from the three-dimensional CAM volume or surface model provided by the customer or created on site from paper plans, the Technology Transfer Center uses special software like Strim 100, Idea and Pro

Engineer to check topological consistency (closed envelopes) and generate automatic part meshing while keeping chord errors and surface evenness under control. Processing ends with the creation of an STL-format facet file—the special interface to the prototyping systems. Direct links with customer CAM engineering and design departments are planned in order to improve the efficiency of this phase.

[Box, p 32]

#### A University-Industry Interface

The main goal of the one-year-old Technology Transfer Center at Le Mans is to promote interaction between the university of the Maine and manufacturers in order to meet the R&D and industrialization needs of manufacturers. It assists companies by providing various services (R&D or fabrication contracts, consulting, training, etc.). Its major strength is that it offers the fastest turnaround time. With the skills of the university laboratories and the University Institute of Technology for Mechanical Engineering behind it, this new center focuses on three areas of activity: computer-integrated manufacturing, materials, and acoustics. The computer-integrated manufacturing department represents an investment of Fr5 million. The two other groups are in the process of acquiring high-performance equipment: an atomic-powered tunnel-effect microscope, an RMN apparatus, and a surface-processing plasma reactor for the materials department, plus three large acoustic rooms (semi-anechoic, reverberating, and diagonal). Some of these tools, which supplement those of the university, stand out even on a European scale.

All of this represents an investment of F34 million, funded by ERDF (European Regional Development Fund) and the local communities.

#### French Forging Firms Launch Simulation Program

93WS0135A Paris AFP SCIENCES in French  
12 Nov 92 p 27

[Unsigned article: "Five Forging Research Programs Launched in 1992"]

[Text] Paris—Nineteen groups or companies representing an important portion of the national forging industry production potential have associated themselves with six research centers early this year to conduct joint research on forging simulation, a vital direction for this industry's future.

Five research programs have been initiated and according to a statement from the Technical Center for Mechanical Industries (CETIM) on 4 November, "a first evaluation of these efforts can now be made, aimed at transferring the results to enterprises supporting this activity."

This project is scheduled to take place over three years at a cost of over 10 million French francs [Fr], financed 50 percent by industrialists and 50 percent by the research budget of CETIM and COREM (Mechanical Research Centers Coordinating Committee). The forging industry in France represents about 130 enterprises and 10,000 people, 400,000 tons of parts, for a volume of Fr7 billion per year.

CETIM emphasizes that this concerted research effort is aimed at improving scientific knowledge on forged shaping and at using this new information to speed up the development of a finite element digital simulation software program known as FORGE 2, selected by the enterprises associated with the project. This software was developed by CEMEF (Materials Shaping Center) and was installed some months ago at CETIM in order to promote digital simulation in industry, stimulate training programs, and provide design assistance.

In order to ensure follow-up as well as technical, scientific, administrative, and financial management of this research, the manufacturers have designated a project leader, an industry coordinator, a scientific manager, and a steering committee.

#### German Firm Develops Ultrasonic Measuring Device

93MI0251 Bonn DIE WELT in German 7 Jan 93 p 7

[Article by Maren Schuepphaus: "Precise Millimetric Measurement From Inaudible Sound"]

[Text] Even ultrathin, hot, or rapidly moving materials can easily be measured using ultrasonics, and a measuring device developed by a firm called Dr. Opara KG from Erftstadt, near Cologne, uses what is known as the ultrasonic pulse echo method to perform contactless measurements on workpieces.

The principle is as follows: Small transmitters emit ultrasonic pulses that are reflected off the object being measured. The echo is picked up by sensors, converted into an electrical pulse, and fed into a small computer built into the measuring device.

Special mathematical processes can be used to evaluate the signals thus received at very high speed, and the results, which are accurate to one-hundredth of a millimeter, are issued in cycles of 10 milliseconds.

The supplier of the ultrasonic method maintains that, compared with random sample measurement using slide rules, electrostatic or laser-optic processes, his system offers several advantages: It can measure any object whatsoever, whether its surface is hard or soft, light or dark, rough or smooth, and distortion of the values due to misalignment or compression of the objects or to temperature fluctuations is ruled out with the ultrasonic pulse echo method.

The new devices can be used for tasks such as quality assurance on production lines in the steel and textile industries, where materials frequently have to be subjected to continuous inspection for regular thickness without disrupting the production process.

## MICROELECTRONICS

### Norway: Trondheim Researchers Develop Ultrafast Data Filter Chip

93WS0211D Stockholm NEW SCANDINAVIAN TECHNOLOGY in English No 4, 1992 p 29

[Text] Researchers at the Norwegian Institute of Technology in Trondheim have developed the MS160, an ultra-fast data-filter chip that can search for words and sentences through volumes of data at a rate of 64,000 A4 pages a second.

The chip, which operates at 160 megabytes a second, is twice as fast as any comparable product on the market today and is unique in its ability to search through unstructured data.

Human behavior and the ability to scan data for information in an unstructured manner inspired the thinking behind the processor. The human mind cleverly combines many vague features before deciding if a complex object is of interest, and this is also the method that the MS160 employs.

The MS160 can identify and report occurrences of complex patterns that are themselves composed of simpler patterns within the data stream. At the lowest level, 256 "trained primitive eyes" work continuously and report when the required information is located. The MS160 organizes these primitive eyes into eight blocks (windows) that jointly become a "super-eye." By allowing an array of eight super-eyes to work concurrently, a quite small and simple system can be built to inspect data rates of up to 1.8 billion characters a second.

The MS160 has been developed in association with Microway in Norway over a period of 10 years. Commenting on the new chip, Microway Norway's managing director, Jan Bakke, says: "We believe that the MS160 will become a natural add-on to data sources of the future and will make a broad range of computer applications significantly faster and more user-friendly. With the volume growth of data and the growing complexity of queries, software companies must look for radically different hardware. The MS160 offers such companies a very effective solution to this problem. We estimate that the MS160 will be on the market by the third quarter of 1992."

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## TELECOMMUNICATIONS

### Europesat-1 Financing, Launch Plans Reviewed

93WS01804 Paris LE MONDE in French  
10 Dec 92 p 19

[Article by M.C.I.: "Europesat To Be Launched Before the End of 1994"]

[Text] The 60th Franco-German summit on 3-4 December in Bonn confirmed that the two countries' public telecommunications carriers will be financing the Europesat-1 European direct broadcast satellite. This Eutelsat-implemented satellite is to be launched by the end of 1994 and will broadcast up to 14 television programming schedules in any format for reception by small parabolic antennae. The satellite, which will cost an estimated ECU200 million (including launch by Ariane), is already under construction at Matra-Marconi Space. However, a series of disputes had delayed the final decision on the project (LE MONDE 5 May and 19 Oct).

The French and the Germans took turns jibbing at launching a series of satellites (eventually using up to 40 frequencies) to replace the aging TDF1, TDF2, and TV-Sat at the same 19° West orbital position. The agreement provides for the allocation of eight channels to the Bundespost for the private and public German networks and four channels to France Telecom for the French networks. The Swiss telecommunications carrier may also apply for a channel.

For the Bundespost, the Europesat venture is a means of competing with the growing hold of the Luxembourg Astra satellite system on its market. For France Telecom, the agreement is a token of Franco-German solidarity, which should also be expressed at the upcoming Edinburgh summit through explicit, joint support of the European plan for high-definition television. After having worked together to build the TDF and TV-Sat satellites, the French and the Germans are preparing for joint operation at the orbital position allocated to them.

### UK: Report Emphasizes Need for Synchronous Digital Hierarchy Technology

93WS0211B Chichester INTERNATIONAL TELECOMMUNICATIONS INTELLIGENCE in English 14 Dec 92 pp 1, 3

[Text] High-speed fibre-optic networks conforming to synchronous digital hierarchy (SDH) standards will be the key to competitiveness in telecommunications transmission markets, according to telecommunications consultants at Analysys Ltd, based in Cambridge in the UK.

They warn that failure to deploy SDH technology rapidly and efficiently will spell disaster for Europe's public telecommunications operators (PTOs) in the face of strong competition from new network operating companies springing up throughout the continent.

**Because new network providers will be using SDH too, PTOs must exploit the benefits of SDH or lose out on both price and performance. The approach and timing of their roll-out strategies will be crucial in determining their ability to protect market share and sustain revenues in the 1990s.**

That is the main conclusion of a report entitled: "SDH: Strategies, Benefits and Technology," recently published by Analysys. It examines the actual deployment plans of the PTOs and assesses the financial consequences of three types of deployment strategy: top-down, overlay or bottom-up. The report shows that SDH can bring savings in capital investment of between 20 percent and 30 percent compared to continuing with the older PDH (Plesiochronous Digital Hierarchy) technology. But, Analysys cautions against ripping out existing PDH network equipment before it has reached the end of its economic life, because of the cash flow implications.

The most financially-attractive approach is the "bottom-up" strategy—deploying SDH in islands in the local network first, and linking them as demand increases. However, an extensive survey of PTO's implementation plans shows that there is no clear consensus among the operators about when and where SDH should be deployed.

"One of the most important conclusions of our research is that SDH will be the technology of choice for new operators wishing to build greenfield networks whether they are trans-European or country-specific networks," said Susan Ablett, Senior Editor of Analysys Publications and lead author of the report. "This means that PTOs must modernise both their networks and their approach to their customers if they are to be ready to compete," she comments.

"The new operators will have none of the problems of migration from an old, inflexible network architecture based on outdated communications requirements. They will be able to deploy SDH networks immediately to where demand is greatest. By taking advantage of the superior network management facilities of SDH, they will also be able to offer high-speed circuits for LAN-interconnect and video and image transmission, with fast response to user requirements—including bandwidth-on-demand. They will therefore offer a significant challenge to incumbent PTOs in the lucrative business market."

SDH also represents major challenges for the transmission equipment manufacturers. In spite of the prospects of new markets and new opportunities, the report forecasts a tough time ahead for the SDH manufacturers. It predicts fierce competition as they struggle to achieve the market share necessary to sustain continued development of their SDH product lines. Ever-shortening life cycles of less than three years between generations of equipment will place additional pressure on traditional European transmission equipment manufacturers. At

the same time, the Europeans will face increased competition from North American and Japanese suppliers. A shake-out in the number of suppliers will be needed before SDH prices stabilise.

But Ablett believes that PTOs will welcome this increased competition since it will ease the introduction of SDH into their networks, although they will also need to monitor changes in regulation and market demand.

"Although PTOs have tended to view SDH as primarily their technology, providing improved efficiency and flexibility in the management of networks, the logic of SDH is that flexible provisioning for users is only one step on from flexible provisioning for PTOs," comments Peter Aknal, another of the report's authors.

He cites the example of the United States: "Experience shows that users have a requirement for the speeds and flexibility offered by SONET, the North American precursor of SDH, and demonstrates that in a competitive regulatory environment, operators are willing to provide users with what they want," he said.

Aknal explains: "Synchronous Digital Hierarchy is the next-generation transmission technology for telecommunications operators. It will provide vastly increased bandwidth and management capabilities, but it will use the same optical fibre cables that provide the physical infrastructure for today's Plesiochronous Digital Hierarchy networks." This makes it extremely attractive to PTOs, as it does not force them to rip out their existing networks.

SDH also offers enormous potential benefits to new network operators, such as those in the UK, and the new trans-European operators envisaged in the European Commission's Review of the Services Directive. Its advantages in terms of capacity, efficiency and flexibility combine to make it a far more attractive prospect than PDH for any company building a network from scratch.

SDH offers the potential for faster provision of circuits, at much higher bandwidths and—at much lower tariffs. All of these things have been on the agenda of user groups for nearly a decade. SDH networks operating at 155 Mbit/s (STM-1), 822 Mbit/s (STM-4) and 2.5 Gbit/s (STM-16), together with the management capabilities offered by the emerging Telecommunications Management Network (TMN) standard, hold out the promise of delivering the price/performance users require.

The outlook for European SDH equipment manufacturers is more mixed. Two main factors are at work: the rate of growth of the SDH market, and the level of competition from North American and Japanese competitors. Since the largest customers, the PTOs, are unlikely to rip out their existing networks, there is a fundamental limit on the rate of growth of the SDH market. This will place pressure on SDH suppliers to prove benefits, cut costs and to develop and release full TMN products. For the North American and Japanese

suppliers, SDH represents their first real opportunity to test the existence of the open market and of open PTO procurement policies.

"SDH—Strategies, Benefits and Technology," by Susan Ablett, Peter Aknal and Bram Moerman, is published by Analysys Publications. Call +44 (0)223 460600 for details.

### Finnish Nokia Wins Major GSM Contract in Netherlands

*93WS0211C Chichester INTERNATIONAL TELECOMMUNICATIONS INTELLIGENCE in English 14 Dec 92 pp 4, 5*

[Text] Finland's Nokia Telecommunications has made what it says is a "major breakthrough" in the Dutch market with the award of a contract to supply GSM base

stations for the first phase of PTT Telecom Nederlands GSM network project. The value of the contract has not been disclosed.

The contract includes the supply of 300 base stations, base station controllers and an operation and maintenance centre. Deliveries will begin early next year and the equipment will be installed in the Randstad area between Amsterdam, Utrecht and Rotterdam.

Infrastructure for PTT Telecom's GSM offering, ATF4, is being supplied by the ECR900 consortium comprising Alcatel, Nokia and AEG. According to Nokia, this latest contract is a continuation of ECR900 deliveries and completes PTT Telecom's phase one GSM project.

Nokia Telecommunications has been active on the Dutch market for several years supplying a range of transmission equipment and network management systems, and is the supplier for the Dutch PTT's nationwide trunking network called TRAXYS.

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